PB86-910203

SELECTED WATER RESOURCES ABSTRACTS

VOLUME 19, NUMBER 3
MARCH 1986

W86-00614 -- W86-00919
CODEN: SWRABW

SELECTED WATER RESOURCES ABSTRACTS (SWRA) is produced by the Geological Survey, U.S. Department of the Interior, and published monthly by the National Technical Information Service (NTIS), U.S. Department of Commerce.

SWRA is available to Federal agencies and their contractors or grantees in water resources research upon request, citing contract or grant number and sponsoring agency. Write: Water Resources Division, U.S. Geological Survey, MS 425, Reston, VA 22092. The **SWRA Journal** is also available on subscription from NTIS, 5285 Port Royal Road, Springfield, VA 22161. Annual subscription rates for the North American Continent are: Journal only, $115, Journal and Annual Indexes, $145; Indexes only, $50. Other addressees, write for prices.

Some documents abstracted in this journal can be purchased from NTIS. Price codes are given in the entries and a current code-price conversion table is printed on the outside back cover. Other documents are available from originating organizations or authors as indicated in the citation.

SELECTED WATER RESOURCES ABSTRACTS

A monthly publication of the Geological Survey
U.S. Department of the Interior

VOLUME 19, NUMBER 3
MARCH 1986

W86-00614 -- W86-00919

The Secretary of the Interior has determined that the publication of the periodical is necessary in the transaction of the public business required by law of this Department.

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.

PREFACE

Selected Water Resources Abstracts, a monthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. These documents cover water resources as treated in the life, physical, and social sciences and the related engineering and legal aspects of the characteristics, supply condition, conservation, control, use, or management of water resources. Each abstract includes a full bibliographic citation and a set of descriptors which are listed in the **Water Resources Thesaurus.** The abstract entries are classified into 10 fields and 60 groups similar to the water resources research categories established by the Committee on Water Resources Research of the then Federal Council for Science and Technology.

Selected Water Resources Abstracts is designed to serve the scientific and technical information needs of scientists, engineers, and managers as one of several services of the Water Resources Scientific Information Center. The cumulative SWRA file from 1968 and monthly updates are available also in magnetic tape through lease from NTIS.

THE WATER RESOURCES SCIENTIFIC INFORMATION CENTER DOES NOT PROVIDE COPIES OF DOCUMENTS ABSTRACTED IN THIS JOURNAL. Sufficient bibliographic information is given to enable readers to order the desired documents from local libraries or other sources.

Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Water Resources Scientific
Information Center
U.S. Geological Survey
MS 425 National Center
Reston, VA 22092

CONTENTS

SUBJECT FIELDS AND GROUPS

Please use the edge index on the back cover to locate Subject Fields and Indexes.

01 NATURE OF WATER

Includes the following Groups: Properties; Aqueous Solutions and Suspensions.

02 WATER CYCLE

Includes the following Groups: General; Precipitation; Snow, Ice, and Frost; Evaporation and Transpiration; Streamflow and Runoff; Groundwater; Water in Soils; Lakes; Water in Plants; Erosion and Sedimentation; Chemical Processes; Estuaries.

03 WATER SUPPLY AUGMENTATION AND CONSERVATION

Includes the following Groups: Saline Water Conversion; Water Yield Improvement; Use of Water of Impaired Quality; Conservation in Domestic and Municipal Use; Conservation in Industry; Conservation in Agriculture.

04 WATER QUANTITY MANAGEMENT AND CONTROL

Includes the following Groups: Control of Water on the Surface; Groundwater Management; Effects on Water of Man's Nonwater Activities; Watershed Protection.

05 WATER QUALITY MANAGEMENT AND PROTECTION

Includes the following Groups: Identification of Pollutants; Sources of Pollution; Effects of Pollution; Waste Treatment Processes; Ultimate Disposal of Wastes; Water Treatment and Quality Alteration; Water Quality Control.

06 WATER RESOURCES PLANNING

Includes the following Groups: Techniques of Planning; Evaluation Process; Cost Allocation, Cost Sharing, Pricing/Repayment; Water Demand; Water Law and Institutions; Nonstructural Alternatives; Ecologic Impact of Water Development.

07 RESOURCES DATA

Includes the following Groups: Network Design; Data Acquisition; Evaluation, Processing and Publication.

08 ENGINEERING WORKS

Includes the following Groups: Structures; Hydraulics; Hydraulic Machinery; Soil Mechanics; Rock Mechanics and Geology; Concrete; Materials; Rapid Excavation; Fisheries Engineering.

09 MANPOWER, GRANTS, AND FACILITIES

Includes the following Groups: Education—Extramural; Education—In-House; Research Facilities; Grants, Contracts, and Research Act Allotments.

10 SCIENTIFIC AND TECHNICAL INFORMATION

Includes the following Groups: Acquisition and Processing; Reference and Retrieval; Secondary Publication and Distribution; Specialized Information Center Services; Translations; Preparation of Reviews.

SUBJECT INDEX

AUTHOR INDEX

ORGANIZATIONAL INDEX

ACCESSION NUMBER INDEX

SELECTED WATER RESOURCES ABSTRACTS

2. WATER CYCLE

2A. General

MODELING HYDROCLIMATIC PROCESSES IN LARGE WATERSHEDS,
California Univ., Davis. Dept. of Geography.
M. L. Shelton.
Annals of the Association of American Geographers, Vol. 75, No. 2, p 185-202, January, 1985. 5 Fig, 5 Tab, 42 Ref.

Descriptors: *Model studies, *Watershed, *Rainfall-runoff relationships, *Deschutes River Basin, *Oregon, *Hydrologic models, Climatology, Spatial distribution, Simulation.

A spatially disaggregate moisture budget (SDMB) watershed model is presented. The model is designed to simulate the hydrologic response of a large, heterogeneous basin by emphasizing moisture accounting within functionally discrete units in both the horizontal and vertical dimensions. Simulation of the precipitation-runoff process is achieved by dividing the watershed into homogeneous domains or sectors that act independently. Each sector is represented vertically as a four-layer configuration composed of surface, soil root zone, transient groundwater, and perennial groundwater subsystems joined in series. The response of the total watershed is represented by an area-weighted combination of moisture fluxes for each of the separate sectors. Averaging or lumping of model variables achieved through spatial disaggregation of the watershed helps to reduce uncertainty concerning the mangitudes and the spatial and temporal attributes of inputs, outputs, and storages. This conceptual structure permits the model to utilize readily available climatic data, to incorporate a prior knowledge of the physical characteristics of the watershed, and to be adaptable for simulating land use changes. Analysis of spatial and temporal variations in hydroclimatic processes in the Deschutes River Basin in Oregon demonstrates the ability of the model to simulate the transformation of precipitation into runoff in a complex hydrologic setting. (Baker-IVI)
W86-00647

RATE OF BACTERIAL MORTALITY IN AQUATIC ENVIRONMENTS,
Brussels Univ. (Belgium). Lab. d'Oceanographie.
P. Servais, G. Billen, and J. V. Rego.
Applied and Environmental Microbiology, Vol. 49, No. 6, p 1448-1454, June, 1985. 10 Fig, 1 Tab, 32 Ref. Syndicat des Communes de la Banlieue de Paris pour les Eaux contract 30/83 and EEC contract ENV-522-B(RS).

Descriptors: *Bacteria, *Mortality, *Aquatic environment, Radioisotope studies, Tritium, Zooplankton, Grazing, Filtration.

A method is proposed which provides a minimum estimate of the rate of bacterial mortality in growing natural populations of planktonic bacteria. This estimate is given by the rate of decrease of radioactivity from the DNA of a tritiated thymidine-labeled natural assemblage of bacterial after all added thymidine has been exhausted from the medium. Results obtained from river water, estuarine water, and seawater show overall bacterial mortality rates in the range 0.010 to 0.030/h, in good agreement with the range of growth rates measured in the same environments. Use of selective filtration through Nuclepore filters (pore size, 2 mu m) allowed the determination of the contribution of microzooplankton grazing to overall bacterial mortality. Grazing rates estimated by this method ranged from 0 to 0.02/h. (Author's abstract)
W86-00777

FLOWING WATER RESOURCES,
Health Effects Research Lab., Research Triangle Park, NC. Criteria and Special Studies Office.
L. E. Keup.
Water Resources Bulletin, Vol. 21, No. 2, p 291-296, April, 1985. 1 Fig, 1 Tab, 10 Ref.

Descriptors: *Water resources, *Streams, *Rivers, Stream order, Stream morphology, Flow discharge, Water management.

Using data related to stream order and the morphological characteristics associated with streams of different discharge rates, an estimate of the river resources of the United States is made. The national totals are: 3,200,000 miles total length of rivers; 15,000 square miles of river surface; and 29 cubic miles of water stored in river channels. Using the same techniques, more exact estimates may be made for individual river basins. Suggestions are given for application of the techniques and river data in the management of water resources. (Author's abstract)
W86-00791

INFLUENCES OF SNOW COVER AND SOIL MOISTURE ON MONTHLY AIR TEMPERATURE,
Illinois Univ. at Urbana-Champaign. Dept. of Atmospheric Sciences.
J. E. Walsh, W. H. Jasperson, and B. Ross.
Monthly Weather Review, Vol. 113, p 756-768, 1985. 15 Fig, 1 Tab, 31 Ref. NSF grant ATM-8313726.

Descriptors: *Snow cover, *Soil water, *Air temperature, Climatology, Precipitation, Model studies, Monthly variation, Seasonal variation.

A series of objective specification experiments were performed with monthly 700 mb heights and surface station temperatures for the United States during 1947-80. The errors in these specifications were used in conjunction with observed snow cover and a computed soil moisture index to assess the impacts of a variable surface state on monthly surface air temperature. Over the eastern and central United States, the mean errors of temperature specifications for the winter months vary by 1-2 C according to the sign of the anomaly of snow cover. Lag results suggest that snow cover can make a modest contribution to the skill of temperature predictions near the snow boundary. The summer specifications were evaluated in terms of a soil moisture index computed from monthly temperatures and precipitation amounts using a modified Thornthwaite/Nappo parameterization scheme. This index varies seasonally in a realistic manner, while the corresponding mean annual runoff is shown to agree well with runoff amounts derived from observed streamflow data. The soil moisture index shows coherent and physically plausible associations with temperature in the central and western United States. In these regions, the mean errors of the temperature specifications vary by approximately 0.5 C according to the sign of the soil moisture anomaly. Impacts of this magnitude are smaller than those obtained in recent general circulation model experiments, but are statistically significant at most stations in the west-central portion of the country.
W86-00860

2B. Precipitation

SEASONAL PRECIPITATION FORECASTING WITH A 6-7 MONTH LEAD TIME IN THE PACIFIC NORTHWEST USING AN INFORMATION THEORETIC MODEL,
Entropy Ltd., Lincoln, MA.
R. A. Christensen, and R. F. Eilbert.
Monthly Weather Review, Vol. 113, No. 4, p 502-518, April, 1985. 6 Fig, 13 Tab, 43 Ref, 2 Append.

Descriptors: *Precipitation, *Forecasting, *Model studies, *Washington, *Oregon, Entropy minimax analysis, Seasonal variation, Prediction, Statistical analysis.

An entropy minimax analysis for the forecast of seasonal precipitation with a 6-7 month lead time was performed for two regions in the Pacific Northwest. A model for the forecast of winter precipitation in the Willamette Valley, Oregon was developed using the 92 year period 1854-1945 for model building. Predictions made for the reserved test years 1946-82 had a 74% accuracy. Statistical test establish a 99% confidence that this success is not due to chance. Models for the forecast of winter and spring precipitation in eastern Washington were developed using the 73 year period 1873-1945. The winter model had 69% predictive accuracy on the test years, with a 97% confidence agains chance. The spring model had an accuracy of 54%, which is statistically indistinguishable from chance. Further analysis reveals that the spring model had an accuracy of 67% for the period 1946-63 and 43% for the period 1964-82, with an 88% confidence against the accuracy decrease arising from chance. This suggests a marginal validity period for the spring model in the order of 15 years following the model building period. The accuracies of the winter model for both western Oregon and eastern Washington show fair uniformity throughout the 37 year test period, with a slight downward trend in the later portion. (Author's abstract)
W86-00778

RAIN ESTIMATION IN EXTRATROPICAL CYCLONES USING GMS IMAGERY,
Bureau of Meteorology, Melbourne (Australia).
R. DelBeato, and S. L. Barrell.
Monthly Weather Review, Vol. 113, p 747-755, May, 1985. 8 Fig, 1 Tab, 14 Ref, 1 Append.

Descriptors: *Rainfall distribution, *Japanese Geostationary Meteorological Satellite, *Remote sensing, *Cyclones, *Australia, Clouds, Blackbody temperature, Satellites, Meteorology, Data interpretation.

A technique was developed which provides estimates of rainfall from extratropical cyclones over an area of 125,000 sq km in southeastern Australia in simulated real time conditions. It utilizes a statistical relation between blackbody temperature of cumuliform cloud and 90 minute rainfall totals to determine estimates of rainfall from cumuliform cloud, and approximates the lesser rainfall amounts from the stratiform pre-frontal cloud as a fixed proportion of rain from equivalent cumuliform cloud. It is based on the digitized 'HR Fax' imagery received at 3 h intervals from the Japanese Geostationary Meteorological Satellite (GMS). Five case studies are presented, each for a 24 hour period. Rainfall estimates for rainfall districts within the area vary from the observed district averages, which were calculated from daily gage data, by an average of 22%. The mean absolute error for districts is 4.2 mm. (Author's abstract)
W86-00859

2C. Snow, Ice, and Frost

SNOWMELT ENERGY BUDGETS IN SOUTHERN AND EAST-CENTRAL WISCONSIN,
San Diego State Univ., CA. Dept. of Geography.
E. Aguado.
Annals of the Association of American Geographers, Vol. 75, No. 2, p 203-211, June, 1985. 6 Fig, 4 Tab, 16 Ref.

Descriptors: *Snowmelt, *Energy budget, *Wisconsin, Solar radiation, Snowpack, Melting, Melt water, Computers, Simulation, Model studies.

Computer simulation has been used to understand the energy balance characteristics of melting covers in the open in southern and east central Wisconsin. The formulation and testing of a descriptive model of snowmelt that relates the phenomenon to previous episodes of accumulation and melt, rather than simply to current meteorological and irradiance conditions, was also explored. Sensible heat flux into the snow was the greatest source of melt energy throughout the 12 years for the majority of days and episodes. Solar irradiation frequently dominated the energy regime, especially when melt occurred late in the season and after large snow accumulations. The effect of prior accumulation and melt on snowpack energetics was discussed and illustrated by the results of the model applied to a year with an unusually deep and long standing snowpack. Snowmelt in Wisconsin occurs throughout a wide range of meteorological and solar irradiance conditions. As the devel-

opment of temperature index models is dependent on the assumption that the relative importance of turbulent and radiative fluxes is nearly invariant, it is unlikely that simple predictive equations are going to be formulated. Such models must include the time of year and the responsiveness of the snow to the various heat inputs. (Baker-IVI)
W86-00648

ESTIMATING REGIONAL SNOW WATER EQUIVALENT WITH A SIMPLE SIMULATION MODEL,
Pacific Southwest Forest and Range Experiment Station, Berkeley, CA.
R. C. Kattelmann, N. H. Berg, and M. K. Pack.
Water Resources Bulletin, Vol. 21, No. 2, p 273-280, April, 1985. 5 Fig, 1 Tab, 20 Ref.

Descriptors: *Snowpack, *Simulation, *Computer models, Model studies, Water equivalent, Precipitation, Air temperature, Snowmelt, Rainfall, Snow cover.

A simple water balance approach is applied to snowpack in this simulation model. Solid precipitation increases snowpack water equivalent as does rain in amount less than the water holding capacity. Rain in excess of the retention capability drains through the pack without adding to the water equivalent. Melting reduces the water equivalent when the pack is saturated with liquid water. The model estimates average snow water equivalent for rectangular subregions in the area. A snowpack water balance is maintained for each subregion on the basis of the average meteorological conditions calculated for the particular subregion. Static subregion characteristics, daily precipitation and mean and minimum air temperatures measured at three index stations are the only needed input values. The model was developed empirically, and each component represents an average condition within the ranges of different meteorological events. Unusual events at the extremes of these ranges may be poorly simulated. The model appears to perform well as indicated by comparison with point measurements of snowpack water equivalent. The mode has a relatively short computer program and run-time, and produces easily interpretable output. (Moore-IVI)
W86-00789

2E. Streamflow and Runoff

STOCHASTIC FLOOD ANALYSIS IN A REGION OF MIXED GENERATING PROCESSES,
Saskatchewan Univ., Saskatoon. Dept. of Geography.
P. R. Waylen.
Transactions of the Institute of British Geography, Vol. 10, No. 1, p 95-108, 1985. 14 Fig, 2 Tab, 22 Ref.

Descriptors: *Stochastic hydrology, *Flood analysis, *British Columbia, Spatial distribution, Flood control, Floods, Streamflow, Snowmelt, Rainfall.

Partial series were obtained from streamflow records of seventeen drainage basins located in southwestern British Columbia. The selection of partial series as a method for analyzing the flood hydrology of a region provides a readily applicable technique which maximizes the use of sample data and provides additional valuable information concerning the frequency and timing of floods. The method is sufficiently flexible that it may be used in a variety of physical environments to provide a satisfactory statistical fit and yet remain physically interpretable. Basins experiencing snowmelt, rainfall and mixed process generated floods are successfuly analyzed in areas receiving between 300 and 3000 mm of annual precipitation. The choice of probability distributions is theoretically based, parameters are estimated easily and permit spatial comparison. The changing values of parameter estimates are strongly linked to the regional flood generating processes. A great deal of their observed spatial variability is explained by changes in the frequency domain of such events rather than their magnitude and timing. In light of these observations a regional approach and extrapolation of process based parameter estimates to basins of interest may be an alternative method of dealing with unusual outliers in flood series. Present engineering practice is to either interpolate between empirical plotting positions or to selectively discard such events. Both techniques lead to poor flood frequency estimates and the loss of valuable regional hydrologic information. Partial series provide the basis of the analysis of annual floods and daily maxima and should be considered as a potential method of analyzing other hydrometeorological extremes. (Baker-IVI)
W86-00646

SNOWMELT ENERGY BUDGETS IN SOUTHERN AND EAST-CENTRAL WISCONSIN,
San Diego State Univ., CA. Dept. of Geography.
For primary bibliographic entry see Field 2C.
W86-00648

STORM WATER RUNOFF FROM INDUSTRIAL SITES,
Baxter and Woodman, Inc., Crystal Lake, IL.
For primary bibliographic entry see Field 5B.
W86-00766

APPLICATION OF SIMPLE MOISTURE ACCOUNTING MODELS TO UNGAUGED CATCHMENTS,
Severn-Trent Water Authority (England).
J. Pirt, and E. A. Bramley.
Journal of the Institution of Water Engineers and Scientists, Vol. 39, No. 2, p 169-177, April, 1985. 5 Fig, 5 Tab, 6 Ref.

Descriptors: *Runoff, *Mathematical models, *Moisture accounting models, Geology, Morphology, Flow forecasting, Simulation, Design flow, Baseflow, Channel routing, Hydrological models, Model studies, England.

Adaptation of a simple, isolated events model (IEM4) to ungauged areas, using catchment geology and morphology to estimate model parameters, produced encouraging estimates of model parameters for design flow prediction, real-time flow forecasting, and flow simulation. The model involves eight parameters: 'groundwater reservoir factor' controlling the rate of baseflow, 'channel routing factor' controlling the effect of channel size on hydrograph shape, 'time delay before hydrograph rise', 'duration of hydrography response', 'runoff percentage at zero soil moisture deficit (SMD)', 'decay rate of run-off percentage/SMD function', 'maximum runoff percentage' under saturated soil conditions, and 'maximum percolation rate' to groundwater under saturated soil conditions. Accuracy and reliability of the model and parameter estimation equations were tested on four catchments in England which differed in geology and topography and ranged in size from 50-165 sq km. Flow forecasts were made for three events in each catchment in pseudo real time. The results in Kingston Brook to Kingston and the River Dove to Kirkby Mills had average errors of estimated peak flows and total runoff volumes of 2.5% and 6.6%, respectively. Timings of the peak flows were also accurate. For the Ecclesbourne and Rother catchments, there were noticeable discrepancies in hydrograph shape and volume, but major errors were restricted to only two events, in which hydrograph peak, total volume, and timing were all in error. (Rochester-IVI)
W86-00836

ALLUVIAL FANS: NOVEL FLOOD CHALLENGE,
Riverside County Flood Control and Water Conservation District, CA.
K. L. Edwards, and J. Thielmann.
Civil Engineering, Vol 54, No. 11, p 66-68, November, 1984. 2 Fig.

Descriptors: *Alluvial fans, *Flood plain management, *Carbozon, *California, Land use, Zoning, Flood protection.

Theoretical considerations, combined with information derived from prior flood events, were used to develop a flood management plan for Carbozon, California, which had been severely damaged by flooding. There had been six major floods in Riverside County within the preceding 5 yr when the study was undertaken. In the upstream reaches of the study area, steep slopes of 2-3%, coupled with the erodible alluvial bed material, produce severe and erratic lateral and vertical erosion in the river channel, which may change its course dramatically during floods. The Dawdy method of predicting channel geometry was used with the modification that Manning's equation was substituted for critical depth. The revised method predicted velocities of 10-25 ft/sec, channel depths of 1-3 ft, and channel widths of 100-500 ft in the 100-yr flood. These figures agreed reasonably well with field measurements of recent alluvial floods in the area. In order to allow for flood flow, minimum lot sizes on the alluvial fans in Carbazon were specified at one-third acre and one-half for two of the fans, and 30-35% of each lot had to remain open to pass floodwaters. In areas of Carbazon where flow velocities of 15 ft/sec or higher were expected, no development was recommended; some development would be permitted in areas of lower predicted velocities, but subject to strict floodproofing and development density limits. (Rochester-IVI)
W86-00885

2F. Groundwater

SEISMIC MICROACTIVITY AND WATER LEVEL VARIATION IN INDUSTRIAL AREA NEAR FLORENCE (ITALY),
Florence Univ. (Italy). Ist. di Geologia e Paleontologia.
G. Gabbani.
Bollettino della Societa Geologica Italiana, Vol. 103, No. 1, p 87-95, 1984. 9 Fig, 17 Ref.

Descriptors: *Florence, *Italy, *Seismology, *Groundwater withdrawals, Water level, Industrial development, Geological fractures.

Analysis of seismic microevents close to the Prato Seismological Station (Florence, Italy) showed a puzzling regularity: the seismicity was practically absent during the night and holidays, while it increased during the working hours, reaching a peak in the late afternoon and then sharply declining. Through the use of a portable seismometer it was possible to ascertain with reasonable confidence that the origin of the microseismicity is located under the industrial settlement of Montemurlo. This particular settlement has grown in the last 20 years. Microevents recorded with magnitudes of 1.6-1.9 and distances of about 7.0 km were selected and their daily and weekly distributions were compared with corresponding trends of the groundwater withdrawal due to the industrial activities. Fluctuations of the ground water level paralleled the occurrence of microseismicity. Withdrawals may induce displacements in existing faults or fractures. (Baker-IVI)
W86-00632

SECURITY OF GROUNDWATER CATCHMENTS NEAR RIVERS; CHARTS TO DETERMINE THE VARIATION IN THE REPLENISHMENT FLOW (SURETE DES CAPTAGES D'EAU SOUTERRAINE A PROXIMITE DES RIVIERES; ABAQUES POUR DETERMINER L'EVOLUTION DU DEBIT DE REALIMENTATION FLOW),
Laboratoire National d'Hydraulique, Chatou (France).
J. P. Bouchard.
Houille Blanche, No. 1, p 53-71, 1985. 9 Ref, 13 Fig.

Descriptors: *Groundwater recharge, *Water table, *Water quality control, Aquifers, Pumping, Boreholes, Computers, Rivers, Water pollution control, Hydrodynamics.

The security of catchments of ground water in an alluvial water table as regards the pollution of the river requires being able to predict the transient changes in the flowrates and volumes of river water drawn to the borehole when pumping is

stopped. These values were determined by a computer program for different cases and are shown on charts. The parameters taken into account are the hydrodynamic characteristics of the water table, the flowrate and geometry of pumping, the lateral replenishment of the water table and possible obstruction of the riverbed. (Author's abstract)
W86-00656

EFFECT OF GROUNDWATER ON SOIL FORMATION IN A MORAINAL LANDSCAPE IN SASKATCHEWAN,
Saskatchewan Univ., Saskatoon. Saskatchewan Inst. of Pedology.
J. J. Miller, D. F. Acton, and R. J. St. Arnaud.
Canadian Journal of Soil Science, Vol. 65, No. 2, p 293-307, May, 1985. 9 Fig, 2 Tab, 15 Ref.

Descriptors: *Groundwater, *Moraines, *Saskatchewan, *Soil genesis, Water table, Recharge, Discharge, Soluble salts, Morphology, Carbonates, Leaching.

Soils in a given landscape position in the study area exhibit similar morphological and chemical characteristics, the genesis of which can be related to soil moisture regimes and groundwater flow. Based on study results, it is possible to predict the hydrological characteristics of a soil from its landscape position, morphology, and classification. Non-saline, non-carbonated Humic Luvic Gleysols occurring in upland depressions are associated with groundwater recharge. Water tables are close to or above the soil surface following spring snowmelt runoff. The infiltration of this water forms groundwater mounds under the depression, which decline gradually over the summer due to recharge and lateral dissipation. Leaching, as indicated by solum depth, is variable between and within the sloughs, and can be related to slough size, shedding area available for surface runoff, and to location within the larger depressions. Soils at locally low elevations include nonsaline and saline soils. Non-saline soils are found in depressions which receive snowmelt runoff in the spring, and consequently are leached of salts. Saline soils occur on lower slope positions, where the water table is always within 2-4 m from the surface, and often within 2 m, enabling the capillary fringe to deposit carbonates and soluble salts close to the surface, through evaporation. Saturated flow may include recharge, discharge, or lateral flow. A wide range in soils occurs on cultivated uplands. Soils on convex slopes are generally shallow and associated with a deep water table and mainly recharge and lateral groundwater flow. Differences in the genesis of these soils result from the degree of slope-influenced moisture redistribution rather than from slope dictated infiltration. Soils on concave slopes can be related to a high water table and/or possibly saturation above frozen subsoil in the spring. (Baker-IVI)
W86-00670

STEP-DRAWDOWN AND CONSTANT-RATE PUMPING TESTS,
D. L. Goodrich.
Waterwell Journal, Vol. 39, No. 5, p 39-42, May, 1985. 1 Tab.

Descriptors: *Step-drawdown tests, *Constant-rate pumping tests, *Pumping tests, *Aquifers, Groundwater, Wells, Pumps, Well yield, Unconsolidated aquifers.

Step-drawdown tests are used to ascertain the present performance of an aquifer, the well, and the pump. Such tests are commonly used to check on the performance of new or established wells completed in unconsolidated aquifers. Specific instructions for conducting step-drawdown and constant-rate pumping tests are given, including setup, equipment, and management during the tests. The results of a step-drawdown test are used to calculate approximate aquifer parameters, the extent of development of a new well, well efficiency, and the operating condition of the pump. The well to be tested should be taken out of service at least 24 hr prior to the test to establish a representative static water level. When testing, discharge should be monitored for sand and entrained air. Constant-rate pumping tests are used to evaluate the yield capacity of an aquifer during extended periods of continuous pumping, usually for a minimum of 3 days. The pumping rate selected must be one that the aquifer, the well, and the pump are capable of maintaining. When properly performed, the test can ascertain the existence of aquifer recharge boundaries and barrier boundaries, and can provide information on the magnitudes of transmissivity and storativity, the two most important aquifer parameters. The tests can also be used to calculate the well's radius of influence. A base-line well should be located at least 1 mile from the pumping well in an unconfined aquifer and at least 2 miles away in a confined aquifer. The test is conducted ideally when ground water levels are at their seasonal low - in late September or October. Steps must be taken to ensure that discharged water does not flood nearby areas or infiltrate back into the aquifer. (Rochester-IVI)
W86-00712

HYDROGEOLOGICAL PROSPECTING GROUP AND TYPES OF MINERAL DEPOSITS FILLED WITH KARST WATER IN CHINA (IN CHINESE).
Acta Geologica Sinica, Vol. 58, No. 2, p 152-164, 1984. 7 Tab, 9 Ref.

Descriptors: *Geohydrology, *Karst, *Minerals, *China (Peoples Republic), Groundwater, Aquifers, Geological fractures, Karst hydrology, Altitude, Caverns, Groundwater level.

It is suggested in this article that the form of potential space filled with water in the karst aquifers is a very important factor to be considered in the classification of hydrogeological prospecting groups of mineral deposits filled with karst water in China. Difference in such spatial forms has relevant effects on the conditions of storage and flowage of the ground water concerned and hence also has great influence on the methods of hydrogeological prospecting and evaluation. The mineral deposits filled with karst water in China may thus be classified into three groups, i.e., mineral deposits filled mainly with karst water in corroded fissures, those in caverns and in ground-rivers, and those in karst passageways. The distribution, hydrogeological features and prospecting perculiarities of each one are duly described. The 'contact' relation, or rather, spatial relation, between the mineral deposits, whether mineral beds or ore bodies, and the rocks or rock formations filled with water also direct influence on the conditions of flow of the karst water into the open pits or underground mines and measures of its prevention. Hence it is an important factor governing the planning of hydrogeological prospecting, including concrete methods, amount of prospecting works, etc. Four types of the mineral deposits in question may be further subdivided on such a basis, viz., mineral deposits with the water-filling rock (rock formation), or karst aquifer, as the direct roof of the mineral beds or ore bodies, with those as the direct floor, with those in the roof but not in direct contact, and with those in the floor but not in direct contact. Among the factors to be taken into consideration in the concrete hydrogeological prospecting are the altitudinal relationships of the mineral deposits and the local base level (of erosion) as well as the ground water level, influence of the surface water, the area of water-filling rock formations (or the catchment area in the case of ground-river and passageway water), degree of development of faulting and fissuring and the conditions of karst collapses in the case of cavern water. The aforesaid groups or types may be divided into simple, intermediate and complex categories so far as the combined effects of these factors are considered. (Author's abstract)
W86-00897

FOSSIL WATER UNDER THE SINAI-NEGEV PENINSULA,
A. Issar.
Scientific American, Vol. 253, No. 1, p 104-110, July, 1985. 7 Fig.

Descriptors: *Aquifers, *Fossil water, *Sinai Desert, *Egypt, *Negev Desert, *Israel, Isotope studies, Springs, Wells, Water resources development, Geology, Geohydrology.

A study of water issuing from springs and wells scattered across the Sinai (Egypt) and the Negev (Israel) deserts has identified a great aquifer formed during the last glacial age. Satellite photographs of the region reveal surface characteristics consistent with subterranean geology that could support an aquifer. Carbon-14 dating puts the age of the water from springs and wells at 20,000 to 30,000 yr. The ages determined from C-14 dating agree with results of hydrological flow models. Water samples from the 'Ayun Musa, from the abandoned oil-exploration well dug into the Nubian sandstone layer in Nakhel and from the artesian wells in the Nubian sandstone layer near the Dead Sea all have the same relative amounts of deuterium and oxygen-18. The chemical and isotopic studies in conjunction with archaeological evidence suggest that the aquifer holds rainwater that was trapped during the most recent ice age. It has been calculated that the Nubian sandstone aquifer under the Sinai and the Negev holds 200 billion cu m of water, 70 billion cu m of which is under the Negev. Agricultural settlements in the Negev demonstrate that the water is low enough in salt content to be suitable for irrigation. (Moore-IVI)
W86-00911

2G. Water In Soils

DETERMINATION OF MOISTURE IN SOLIDS,
Lawrence Livermore National Lab., CA.
J. W. Pyper.
Analytic Chimica Acta, Vol. 170, No. 2, p 159-175, April 1985. 2 Fig, 91 Ref. U.S. DOE contract W-7405-Eng-48.

Descriptors: *Soil water, *Bound moisture, *Free moisture, Sampling, Measuring instruments, Dynamic dielectric thermal analysis, Coherent microwave measurements, Infrared spectrometry, Near-infrared reflectance spectrometry, Thermal methods, Nuclear magnetic resonance spectrometry.

The scientific literature published since Pande's comprehensive monograph Handbook of Moisture Determination and Control (1974) was surveyed (to mid-1984) for new or improved techniques of determining moisture in solids. Particular attention is given to methods that might distinguish between bound and free moisture in organic solids. The classification of moisture is discussed, as well as pitfalls in sampling, in sample handling, and in the comparison of different methods. Six methods that show promise of being able to distinguish between bound and free moisture were identified: dynamic dielectric thermal analysis, coherent microwave measurements, infrared spectrometry, near-infrared reflectance spectrometry, thermal methods and nuclear magnetic resonance spectrometry. (Author's abstract)
W86-00644

SURFACE SOIL WATER CONTENT MEASUREMENT USING PULSED NUCLEAR MAGNETIC RESONANCE TECHNIQUES,
Agricultural Research Service, Beltsville, MD. Hydrology Lab.
R. F. Paetzold, G. A. Matzkanin, and A. De Los Santos.
Soil Science Society of America Journal, Vol. 49, No. 3, p 537-540, May-June, 1985. 6 Fig, 1 Tab, 10 Ref.

Descriptors: *Soil water, *Nuclear magnetic resonance, *Ground truth data, *Measuring instruments, Moisture probe, Soil type, Gravimetric water content.

A tractor-mounted nuclear magnetic resonance (NMR) soil moisture measurement instrument was developed and tested, demonstrating a high correlation between NMR output and volumetric and gravimetric soil moisture. This device may be used for obtaining ground truth data for calibrating and evaluating remotely sensed determinations. NMR

techniques can selectively measure only the hydrogen associated with water. The prototype instrument is composed of two major units, a sensor and an electronics package. The NMR sensor contains the electromagnet, the detection coil, and the tuning capacitor. The electronics package consists of the radio-frequency subsystem, the control and signal-processing subsystem, and the power distribution subsystems; the package is mounted on a 63 horsepower diesel tractor, along with a diesel generator that provides electrical power to the instrument. The sensor assembly has a mass of about 300 kg, and is mounted on the tractor's three-point hitch. Power is supplied to the magnet through the electronics package. About 300 watts are required to create a 55.7 kA/m field at 5 cm. A keyboard-type control console with a thermal printer is mounted inside the tractor cab. Measurement depths of 38, 51, or 63 mm can be selected here. Results are printed automatically, and additional notes can be typed with the output. Stationary measurements on a clay and loamy fine sand in buckets, yielded a linear relationship (r=0.98 at 38 mm, r=0.99 at 51 mm) between NMR signal and volumetric soil water content over the range 5-30% water by weight. Similarly, the gravimetric water content also showed a linear relationship with NMR values (r=0.93 at 38 cm, r=0.96 at 51 cm). In field tests in a clay loam and a gravelly sandy loam, gravimetric water content and NMR signal showed a linear correlation (r=0.92). Results with a stationary instrument or one moving at 26 cm/sec did not differ. Maintaining contact between the sensor and the soil surface was difficult in the clay loam soil. (Rochester-IVI)
W86-00698

SOLUTE DISPERSION DURING AXISYMMETRIC THREE-DIMENSIONAL UNSATURATED WATER FLOW,
Department of Scientific and Industrial Research, Palmerston North (New Zealand). Div. of Plant Physiology.
B. E. Clothier, and D. E. Elrick.
Soil Science Society of America Journal, Vol. 49, No. 3, p 552-556, May-June, 1985. 3 Fig, 1 Tab, 11 Ref.

Descriptors: *Solute transport, *Dispersion, *Unsaturated flow, Mathematical studies, Infiltration, Hydrodynamics, Convection, Wetting, Soil water, Bromides.

An approximate, analytic solution is presented for the smearing of solute by both convection and dispersion during axisymmetric three-dimensional constant flux infiltration from a surface point source in unsaturated soil. The steady-state pattern of axisymmetric streamlines is used to track individual parcels of water as they move away from the surface emitter. A simple analytic expression is developed to describe the time course of the hydrodynamic dispersion of solute about the convected front as it moves along any given streamline. The location of the convected front at any time is predicted from the profile of wetting along that streamline. The plane-of-separation concept is used to find the distance travelled by the convected front along the streamline. The invading solution is considered to act as if to effectively piston-displace the antecedent soil water. Profiles of bromide concentration along three streamline paths were measured during constant-flux point-source infiltration experiments in the laboratory with fine sand. These measurements compared favorably with the theoretical predictions. (Author's abstract)
W86-00700

SOLUTE DISCHARGE DURING STEADY WATER DRAINAGE FROM A SAND TANK,
Florida Univ., Gainesville. Dept. of Plant Pathology.
R. S. Mansell, P. J. McKenna, and M. E. Hall.
Soil Science Society of America Journal, Vol. 49, No. 3, p 556-562, May-June, 1985. 10 Fig, 2 Tab, 12 Ref.

Descriptors: *Drainage, *Solute transport, Simulation, Mathematical models, Saturated flow, Infiltration, Soil water, Boundary conditions, Breakthrough curve.

An alternating direction implicit (ADI) numerical method was used to simulate transient solute movement resulting from a step-function increase of solute concentration in water applied to a shallow sand tank system with a subsurface drain. Steady water flow in the saturated portion of the tank was simulated using an iterative alternating direction implicit (IADI) numerical method. The saturated-unsaturated condition in the actual sand tank was approximated by a smaller rectangular flow region of saturation in the model simulation. Isopleths of hydraulic head and solute concentration within the soil demonstrated a decrease in the rate of infiltration from the point vertically above the drain to the point vertically above the midpoint between the drains. Consequently, solute transport was much faster in the surface soil overlying the drain than in the soil near the mid-point between drains. When cumulative effluent volume was expressed as the number of pore volumes, breakthrough curves for solute concentration in the drainage water revealed early arrival of solute compared to a one-dimensional system. In spite of the different boundary conditions imposed at the soil surface in the tank and in the model, reasonable agreement was obtained between simulated breakthrough curves and experimental data from the sand tank. (Author's abstract)
W86-00701

MONTE-CARLO SIMULATION OF NONINTERACTING SOLUTE TRANSPORT IN A SPATIALLY HETEROGENEOUS SOIL,
Texas A and M Univ., College Station.
N. Persaud, J. V. Giraldez, and A. C. Chang.
Soil Science Society of America Journal, Vol. 49, No. 3, p 562-568, May-June, 1985. 5 Fig, 6 Tab, 26 Ref.

Descriptors: *Monte-Carlo process, *Simulation, *Solute transport, *Soil water, dispersion, Interstitial water, Velocity, Differential equations, Percolation.

Monte-Carlo data generation techniques were used to obtain 200 pairs multivariate lognormal values of the physical parameters D (dispersion coefficient) and v (pore-fluid velocity) which appear in the differential equation describing downward leaching of a noninteracting solute in the soil profile under steady-state percolation. The time (tmax), at which the maximum concentration is attained at given soil depth L after a pulse input of solute has been applied at the soil surface for a time t0, was obtained for each pair of generated D and v values. Values of the ratio delta L/delta tmax representing the average rate of movement of the maximum concentration between two depths were also calculated. The effect of changes in the variance of v and the levels of correlation between D and v on the frequency distribution of tmax-t0 was investigated. The lognormal and gamma distributions were fitted to the calculated distributions of tmax-t0. Good fits were obtained with both theoretical distributions to the values of tmax-t0. The lognormal distribution was better in describing the values of delta L/delta tmax. The parameters and properties of these calculated distributions were sensitive to changes in the variance of v but were less sensitive to changes in the correlation between D and v. The ensemble average of 200 concentration versus time curves was computed by substituting the generated parameters D and v in the solution to the differential equation. This curve was compared to that obtained using the sample mean values of D and v. The dissimilarity between these curves was sensitive to changes in the variance of v. (Author's abstract)
W86-00702

SEEPAGE-LIMITATION OPTIMIZATION OF THE SHAPE OF AN IRRIGATION CHANNEL BY THE INVERSE BOUNDARY-VALUE PROBLEM METHOD,
For primary bibliographic entry see Field 3F.
W86-00869

2H. Lakes

COMPARISON OF THE PHOSPHORUS-CHLOROPHYLL RELATIONSHIPS IN MIXED AND STRATIFIED LAKES,
Alberta Univ., Edmonton. Dept. of Zoology.
E. T. Riley, and E. E. Prepas.
Canadian Journal of Fisheries and Aquatic Sciences, Vol. 42, No. 4, p 831-835, April, 1985. 2 Fig, 1 Tab, 19 Ref.

Descriptors: *Phosphorus, *Chlorophyll, *Mixed lakes, *Stratified lakes, Chlorophyll a, Thermal stratification, Nutrients.

Data from the literature were used to calculate separate regressions of summer chlorophyll a concentration (Chl a) on spring total phosphorus concentration (TP) for lakes that remain thermally stratified during the summer and lakes that mix intermittently during the summer. Significant differences were found in the spring (TP)-summer (Chl a) relationships for the two lake types ($P < 0.05$). The mean ratios of summer (TP) to spring (TP) were also significantly different in stratified and mixed lakes ($P < 0.001$); this difference is the explanation offered for why the spring (TP)-summer (Chl a) relationships were different in stratified and mixed lakes. (Author's abstract)
W86-00614

DISTRIBUTION PATTERN OF DENITRIFYING BACTERIA IN FISH PONDS OF DIFFERING FARMING MANAGEMENTS,
Kalyani Univ. (India). Dept. of Zoology.
B. B. Jana, and G. N. Patel.
Archiv fur Hydrobiologia, Vol. 3, p 291-303, May, 1985. 6 Fig, 4 Tab, 18 Ref.

Descriptors: *Denitrification, *Bacteria, *Fish ponds, Fish management, Fisheries, Fish farming, Nutrients, Organic carbon, Nitrogen, Phosphates, Population dynamics.

The population size of denitrifying bacteria was measured in fish ponds of differing fish farming management practices. Due to different stocking combinations and rearing practices, it was hypothesized that there would be a difference in the population structure of denitrifying bacteria among the ponds used for monoculture, polyculture and traditional systems. Environmental factors responsible for the seasonal variations of denitrifying bacteria in these ponds were identified. Maximum population in monoculture and lowest in traditional types were related to their enrichment properties in terms of organic carbon, inorganic nitrogen and phosphate. Seasonally, bacterial populations peaked in the summer and were reduced in the winter; harmonic analysis of empirical function with 12 ordinates was the best model to predict the annual cycle of DNB in all fish ponds. Stepwise multiple regression analysis between the log values of monthly numbers of bacteria occurring in the fish ponds and the environmental factors revealed that organic C, inorganic N, water temperature and phosphate were perhaps important attributes causing seasonal changes of DNB in these fish ponds. (Baker-IVI)
W86-00622

EVALUATION BY FIELD EXPERIMENTS OF THE MCLAY MODEL OF STREAM DRIFT,
British Columbia Univ., Vancouver. Inst. of Animal Resource Ecology.
P. A. Larkin, and D. W. McKone.
Canadian Journal of Fisheries and Aquatic Sciences, Vol. 42, No. 5, p 909-918, May, 1985. 7 Fig, 6 Tab, 13 Ref.

Descriptors: *Drift, *Mathematical models, *Stream biota, *McLay model, Velocity, Stream flow, Migration, Sampling.

The model of McLay (J. Fish. Res. Board Can. 27:359-370) for describing the drift of stream organisms was tested in a variety of field experiments in which organisms were disturbed from the substrate and/or the natural drift was blocked. In each situa-

tion, appropriate corrections may be made of the catch of drift organisms by the sampling nets. Disturbed animals drifted at a rate much less than stream velocity. The logarithm of the distance travelled was a linear function of the logarithm of mean stream velocity and conformed to the McLay model. Similarly, the model adequately described experiments in which two disturbances were done simultaneously, when drift was blocked for a 2-h period, and when there was both disturbance and blockage. A more comprehensive version of the model was only partially successful in describing the drift at various distances downstream of a blockage sustained for 4 d, probably because of upstream migration of organisms through the substrate, spatial differences in the densities of animals in the substrate, or a reduction in drift rate at lower density in the substrate. (Author's abstract)
W86-00628

CHECKLIST OF PHYTOPLANKTON (EXCLUSIVE OF DIATOMS) IN KENTUCKY RESERVOIR,
Murray State Univ., KY. Dept. of Biological Sciences.
L. E. Barnese, and J. M. King.
Transactions of the Kentucky Academy of Science, Vol. 46, No. 1/2, p 46-50, March, 1985. 1 Fig, 2 Tab, 17 Ref.

Descriptors: *Phytoplankton, *Kentucky Reservoir, *Tennessee River, *Population dynamics, Algae, Seasonal variation.

An attempt was made to identify the phytoplankton species which occur in the lower portion of Kentucky Reservoir. Fourteen collection sites were established between the Tennessee River miles 43.3 and 49,.0 on Kentucky Reservoir. Two sites were located in each of 2 embayments on the western and eastern sides of the reservoir. Six sites were established in the main portion of the reservoir and were situated upriver, between and downriver from the embayments. The study revealed 156 species, varieties and forms representing 59 genera. The green algae dominated the algal flora in all seasons but were most numerous in summer, blue-green algae were most abundant in summer and fall, while euglenoids reached their peak in summer. The number of dinoflagellates was relatively low throughout the year. (Baker-IVI)
W86-00631

BIOLIMNOLOGY OF HARVEYS LAKE,
Wilkes Coll., Wilkes-Barre, PA. Dept. of Biology.
B. B. Smith, and C. B. Reif.
Proceedings of the Pennsylvania Academy of Science, Vol. 58, No. 2, p 131-139, 1984. 3 Tab, 31 Ref.

Descriptors: *Harveys Lake, *Pennsylvania, *Biolimnology, *Plankton, Algae, Copepods, Cladocerans, Rotifers, Zooplankton, Phytoplankton, Population dynamics, Diatoms, Cyanophyta, Chlorophyta, Pyrrhophyta.

The algae of Harveys Lake have been studied very little for a lake of its age and size. It is the largest natural lake in Pennsylvania, with an area of 263 hectares. As a dimictic lake, Harveys Lake is well-stratified during the summer periods. Oxygen concentration in the hypolimnion was 4 ppm just under the thermocline and less than 1 ppm in the deepest part of the lake. Oxygen concentration under the ice was reduced to less than 3 ppm just before the spring breakup. Mean pH values show a downward trend from 7.4 to 6.2 during the last three decades. The lake demonstrated the annual seasonal algal successional pattern typical of temperate dimictic lakes: diatom dominance in winter, chlorophyte abundance in summer and autumn, and blue-green maxima in late summer. Diatoms were present throughout the year, with lowest numbers in summer months. Two blue-green organisms, variously identified as Anabaena sp. and/or Nostoc sp., were present throughout the year, in greater numbers in the summer months but rare in the winter. In other algal groups, Peridinium bloomed in June and Dinobryon was present throughout the year with peaks in March, May, and August. Euglenoids were rare, as was Mallomonas. The zooplankton community appeared to be typical of a lake population and consisted of different species in limnetic and littoral zones. Very few copepods were in the tows or in the squeezes during 1982-83, compared with the numbers observed in samples from Harveys Lake collected in previous years. Cladocerans and rotifers were most abundant with Bosmina and Chydorus present in all samples. (Baker-IVI)
W86-00633

ADDITIONS TO ICHTHYOFAUNA OF THE SUSQUEHANNA RIVER WITH A CHECKLIST OF FISHES OF THE SUSQUEHANNA RIVER DRAINAGE BELOW CONOWINGO DAM,
Radiation Management Corp., Drumore, PA. Muddy Run Ecological Lab.
P. E. McKeown.
Proceedings of the Pennsylvania Academy of Science, Vol. 58, No. 2, p 187-192, 1984. 1 Fig, 1 Tab, 24 Ref.

Descriptors: *Conowingo Dam, *Maryland, *Susquehanna River, *Fish, Population dynamics, Hydroelectric plant, Migration, Distribution.

Conowingo Dam (Maryland) presently acts as an effective barrier to the upstream migration of fishes. Access to the upper Susquehanna River is limited to the transport of select species from the fish collection facility at the Dam. Accessibility of the lower Susquehanna River to upriver migration from the bay region, migration to and from Deer and Octoraro creeks and downriver passage through Conowingo Dam provide a theatre for a diverse fishery. A total of 103 species was recorded for the Susquehanna River Drainage in compiling the ichthyfaunal list. Seventy-two of these fishes are considered native to the River drainage. Of the total number recorded for the drainage, 78 were collected in the lower Susquehanna River during the study period. Fourteen are considered additions to the drainage and were not previously discovered there. (Baker-IVI)
W86-00635

FACTORS CONTROLLING MASS LOSS AND NITROGEN DYNAMICS OF PLANT LITTER DECAYING IN NORTHERN STREAMS,
Marine Biological Lab., Woods Hole, MA. Ecosystems Center.
For primary bibliographic entry see Field 2K.
W86-00637

ALTERATION OF MICROBIAL METABOLIC ACTIVITIES IN ASSOCIATION WITH DETRITUS,
North Carolina Univ. at Morehead City. Inst. of Marine Sciences.
For primary bibliographic entry see Field 2K.
W86-00639

ACCUMULATION OF SEDIMENT ORGANIC MATTER IN A HARDWATER LAKE WITH REFERENCE TO LAKE ONTOGENY,
University of Southern Mississippi, Hattiesburg. Dept. of Biological Sciences.
For primary bibliographic entry see Field 2J.
W86-00643

FRESHWATER AQUACULTURE IN CHINA: ECOSYSTEM MANAGEMENT FOR SURVIVAL,
New Alchemy Inst., East Falmouth, MA.
R. D. Zweig.
Ambio, Vol. 14, No. 2, p 66-74, 1985. 10 Fig, 1 Tab, 26 Ref.

Descriptors: *Fisheries, *China (Peoples Republic), *Aquaculture, Ecosystems, Management, Water resources development, Fish ponds.

The demand for freshwater fish is high in China. The enormous population pressure upon available natural resources in general is perhaps the greatest present environmental concern. The long history of freshwater aquaculture development demonstrates how China's overall food production strategies have come to use intensely her inherent water resources, including ponds, natural lakes and reservoirs. Nonetheless, considerable room exists for expansion of, and improvement in, the overall efficiency of fisheries practices. Various approaches are suggested for lake fisheries, reservoir fisheries and pond fish culture. The matching of feeding habits of fish polyculture to the available nutrients is an important step. There are two pond-fish culture strategies which are most commonly followed in China - stocking and harvesting in rotation and multigrade conveyor culture. With the rotation method, three size classes of each species are stocked in food-fish ponds during February and March. Beginning in July and August and continuing through January, the harvest sized fish are seined from the pond and replaced with fingerlings. The multigrade conveyor method uses a series of ponds with fishes of specific size classes cultured in each pond and moved as they grow. From the last pond, generally the fifth in the sequence, market sized fish are harvested monthy. The latter method is most common in the south of China where year-round, high growth is possible. (Baker-IVI)
W86-00664

RELATIONS BETWEEN PHYTOPLANKTON AND ENVIRONMENTAL FACTORS IN A SMALL, SPRING-MEROMICTIC LAKE IN SOUTHERN FINLAND,
Helsinki Univ., Lammi (Finland). Lammi Biological Station.
L. Arvola, and M. Rask.
Aqua Fennica, Vol. 14, No. 2, p 129-138, 1984. 11 Fig, 1 Tab, 40 Ref.

Descriptors: *Phytoplankton, *Meromictic lakes, *Finland, Lakes, Temperature effects, Seasonal variation, Primary productivity, Zooplankton, Plankton, Nutrients, Stratification, Light intensity, Chlorophyll.

Factors controlling the phytoplankton community in the epilimnion of a steeply stratified lake with restricted turbulence mixing are demonstrated. The study lake, Alinen Mustajarvi, is a small oligomesohumic lake situated in the Evo district in southern Finland. The lake is a groundwater seepage lake, having no inlets and with a very small catchment area. Before ice break, chlorophyll a concentration increased as well as the proportion of small flagellates. A slight maximum of chlorophyll was noted about 2 weeks after the ice break. At the beginning of the thermal stratification algal succession was very rapid. Small Chlorococcales dominated in midsummer, chrysophytes later in summer and in autumn as well as cryptomonads and dinophytes. Generally, smaller species dominated in spring and during summer stratification and larger ones later in summer and in autumn. Factors determining the phytoplankton community seemed to be as follows: before ice break mainly light and temperature, after ice break temperature and nutrients, during summer stratification nutrients and zooplankton grazing, in autumn temperature and nutrients and during the autumn turnover light and temperature. The productivity of the study lake was rather high compared to the other Scandinavian lakes with small surface area and similar physicochemical conditions. Water color was one reason for this because in the study lake the euphotic zone was much deeper than in more colored brown water lakes. (Baker-IVI)
W86-00672

GENERAL LAKE WATER QUALITY INDEX,
National Board of Waters, Helsinki (Finland). Water Research Inst.
V. Malin.
Aqua Fennica, Vol. 14, No. 2, p 139-145, 1984, 7 Fig, 14 Ref.

Descriptors: *Lakes, *Water quality, *Pollution index, Measurement, Cluster analysis, Regression analysis.

A general lake water quality index was sought on the basis of data secured from a network of deep-water lakes during the years 1976-1981. By using

the principal component- and cluster analysis techniques, the variables to be included in the index were chosen from the measured variables. The original measurement data were transformed into quality values using so-called value functions in standard procedures which have been used earlier for the calculation of values of water quality indices. The basic idea behind the construction of the value functions for the general lake water quality index was to develop functions which could indicate how individual measurement results compare with the whole deepwater lake data. Cumulative relative frequencies of the variables of the data under examination were chosen as the basis for developing value functions. Regression analysis was used in developing the value functions used in the index. In most cases the index performed well. (Baker-IVI)
W86-00673

POTENTIALLY TOXIC BLUE-GREEN ALGAE (CYANOBACTERIA) IN FINNISH NATURAL WATERS,
Helsinki Univ. (Finland). Dept. of Limnology.
For primary bibliographic entry see Field 5B.
W86-00674

FILLING IN THE GAP BETWEEN HYDROLOGY AND HYDROBIOLOGY - THE VIEWPOINT OF A HYDROLOGIST,
National Board of Waters, Helsinki (Finland). Water Research Inst.
E. Kuusisto.
Aqua Fennica, Vol. 14, No. 2, p 155-169, 1984. 9 Fig, 39 Ref.

Descriptors: *Morphometry, *Lakes, *Hydrology, Ice cover, Thermal conditions, Water balance, Limnology, Hydrodynamics, Mixing, Water currents.

Considerable progress has been made in recent years in the study of lake hydrodynamics. Hydrodynamic processes occurring in lakes are divided into the following groups: surface phenomena (wind generated waves, wind generated surface oscillations, and waves due to changes in discharge); internal currents (flow through the lake, and currents due to surface movements); and transport phenomena (mixing and stratification, and diffusion). All dynamic processes in a lake are characterized by spatial heterogeneity. This leads to incomplete mixing and uneven distribution of chemical and biological constituents within the water body. Simple mass balance relationships between the inputs of these constituents and their concentrations in water samples are usually not valid. Specific attention is given to wind induced currents, advective currents, convective currents, and dynamic biological limnology. Also discussed are morphometry, thermal conditions, ice and snow cover, and water balance. (Baker-IVI)
W86-00675

WATER QUALITY MODEL FOR LAKE KUORTANEENJARVI, A POLYHUMIC FINNISH LAKE,
Helsinki Univ. of Technology, Espoo (Finland). Dept. of Civil Engineering.
O. Varis.
Aqua Fennica, Vol. 14, No. 2, p 179-187, 1984. 7 Fig, 4 Tab, 11 Ref.

Descriptors: *Polyhumic lakes, *Finland, *Nutrients, *Simulation, *Algal growth, *Lake Kuortaneenjarvi, Eutrophication, Model studies, Phosphorus, Nitrogen, Algal blooms,.

A description is offered of nutrient dynamics and algal growth in a small northern polyhumic lake in terms of mathematical simulation. Lake Kurotaneenjarvi is located in the middle reaches of Lapuanjoki River. The area has a dense population and is rather poor in lakes. Recreational use of this lake is abundant. Slight eutrophication and blooms of blue green algae hinder fisheries and recreational users. Municipal waste waters cause about 5-10% of the total nutrient loading but in the summer this proportion rises to 30%. The application of the systems analysis approach in the modelling context proved helpful. Phosphorus and nitrogen cycles were simulated. Particular attention was given to simulation of blue green algae separately from other planktic algae. Lake Kurotaneenjarvi consists of two basins which both were simulated separately with identical lumped parameters models. The model was calibrated using observations from the upper basin and applied to the lower basin as a preliminary validation. The simulation results of calibrated state variables as regards to correctness with time as well as with level were relatively accurate. The model can be used in estimating the influence of changing nutrient loadings on the lake metabolism. Presumably, it cannot be directly applied to other lake ecosystems. (Baker-IVI)
W86-00677

NATURAL OCCURRENCE OF PIKE-PERCH (STIZOSTEDION LUCIOPERCA (L.)) AND SUCCESS OF INTRODUCTIONS IN RELATION TO WATER QUALITY AND LAKE AREA IN FINLAND,
Finnish Game and Fisheries Research Inst., Helsinki. Fisheries Div.
H. Lehtonen, T. Miina, and T. Frisk.
Aqua Fennica, Vol. 14, No. 2, p 189-196, 1984. 9 Fig, 2 Tab, 11 Ref.

Descriptors: *Lakes, *Finland, *Fish populations, *Pike-perch, Water quality, Limnology, Eutrophication, Phosphorus, Fisheries.

The relative abundance of pike-perch in lakes in Finland and the success of introductions of this species in relation to water quality and the lake area are described. The introductions of the fish are carried out with fry, fingerlings or larger fish with eyed ova. The success of these introductions depends on the quality of the lake and also on the quality and size of the fish used for stocking. Introductions in some areas have succeeded best when yearlings or two-year old pike-perch are used as stocking material. The higher the concentration of phosphorus in the lake, the more successful has been the introduction. In polyhumic lakes the results have often been poorer than elsewhere. Most introductions are carried out in small lakes the majority having a surface area of 3 sq km or less. About half of the introductions into small lakes were successful, whereas in large lakes with areas over 11.7 sq km only 22% of the introductions resulted in self-sustaining populations. It is not clear whether the result of introduction is primarily determined by the lake area or some other factor. It is possible that introductions are carried out more carefully in small than in large lakes because the fishing rights do not belong to so many people and the persons introducing the pike-perch can more often enjoy the results themselves. One reason for better results in small lakes may be that the large lakes suitable for the occurrence of pike-perch have mostly already had natural pike-perch stocks, whereas small lakes have not usually had pike-perch in their original fish fauna. (Baker-IVI)
W86-00678

IODINE CONTENT OF THE TISSUES OF THE VENDACE (COREGONUS ALBULA L.) IN CORRELATION TO THE IODINE CONTENT OF THE AMBIENT WATER,
Kuopio Univ. (Finland). Dept. of Applied Zoology.
E. Lahti, and O. Lindqvist.
Aqua Fennica, Vol. 14, No. 2, p 197-203, 1984. 8 Fig, 2 Tab, 23 Ref.

Descriptors: *Iodine, *Vendace, *Finland, *Fish physiology, Biological magnification, Brackish waters, Oligotrophic lakes, Fish food, Animal tissues, Animal physiology.

The iodine contents in the ambient water was correlated with iodine content in the vendace tissues, which also allows the calculation of the biomagnification factors of this element in the fish tissue. The material was collected in 1980 from the northern part of the Bothnian Bay (brackish water) and from inland lakes in Finland. All lakes represent the oligotrophic or dys-oligotrophic type. The thyroid contained the highest amount of iodine and the muscle, the lowest. Little seasonal variation was evident in the iodine content of the thyroid. Muscle and liver contents were lowest in the summer. Iodine levels in the ovary remained rather unchanged or increased slightly towards the spawning period in the fall. Enrichment coefficients for iodine in the different tissues were generally higher in fish from lakes with low iodine levels, and vice versa. The brackish water is richest in iodine and the vendance tissues there contained the least amounts of the substance. The main route for iodine into the vendace may be through its food, though during the lean seasons it may have to rely on its iodine stores in tissues. (Baker-IVI)
W86-00679

GROWTH IN BIOMASS OF BALANUS BALANOIDES YOUNG AT VARIOUS CURRENT VELOCITIES,
Akademiya Nauk SSSR, Moscow. Inst. of Evolutionary Morphology and Animal Ecology.
B. Y. Vilenkin, N. A. Pertsov, N. A. Plotnikova, and L. P. Tsygankova.
Doklady Biological Sciences, Vol. 278, No. 1-6, p 552-554, March, 1985. 1 Tab, 8 Ref.

Descriptors: *Barnacles, *Biomass, *Current velocity, Growth rates, Water currents, Growth stages, Growth kinetics.

The dependence of total biomass growth of Balanus balanoides young was shown to depend on current velocity approximately according to the Rashevskii hypothesis on steady-state nutrition as first applied by Monod with microorganisms. The equation has the form $k = 0.0496\ U/U + 9.74$, where k is the specific growth rate (per day) and U is the current velocity (cm/sec). The coefficient in the numerator of this equation determines the growth rate that is maximal for the given age, temperature, and experimental conditions, and appears to be a conservative indicator. The coefficient in the denominator is highly dependent on the food concentration in the flowing water medium. The hyperbolic function best corresponding to the experimental data in the present study resembles that long established for concentration dependency of growth (or activity) of microorganisms. Values for the specific rate of biomass growth during the observation of barnacle growth on plates were obtained at four levels of current velocity at which repeatable results were obtained. The specific growth rate was calculated as $k = \ln 1/32$ (L/l), where l is the sum of shell diameters on both plates at the start of the experiment, L is the same sum on day 32. The quantities obtained were as follows: $U = 4.45$, $k = 0.0154$; $U = 8.90$, $k = 0.0253$; $U = 17.80$, $k = 0.297$; $U = 22.45$, $k = 0.0353$. Choice of the Rashevskii hypothesis was based on selection of the most significant linear regression obtained when these data were transformed in various ways. (Rochester-IVI)
W86-00721

EFFECT OF VELOCITY OF WATER FLOW ON GROWTH OF COLONIAL HYDROIDS (HYDROZOA, THECAPHORA),
Moscow State Univ. (USSR).
N. N. Marfenin.
Doklady Biological Sciences, Vol. 278, No. 1-6, p 655-657, March, 1985. 1 Tab, 8 Ref.

Descriptors: *Hydrozoa, *Water currents, *Velocity, *Current velocity, *Animal growth, Growth rate, Feeding, Animal behavior.

Percentage increase in colony size of hydroids generally decreased as current velocity increased over the range 9-75 cm/sec, but there were differences among the four species tested. Obelia loreni (Allm.) grew best at a flow velocity of 9 cm/sec. At 31 cm/sec, a distinct decrease in growth rate was apparent, and at 51 and 75 cm/sec, there was virtually no increase in colony size over 8 days of observation. O. longissima (Pall.) and O. geniculata (L.) colonies ceased to grow only at 75 cm/sec, but O. longissima showed a marked change in rate of increase in colony size at 51 cm/sec. Dynamena

pumila (L.) did not cease growth at any current velocity, but growth was less at the highest and lowest velocities employed. Orientation of the colonies of all species to the direction of water flow did not affect their growth. The mechanism of action of current velocity on growth is linked to feeding behavior - anchoring, retaining, and ingesting the prey (Artemia nauplii) transported past the hydranth by the flow of water. When currents are powerful, pressing of axial shoots to the substrate and lateral branches to the stalk makes feeding difficult or impossible. The species used here have differing degrees of stalk rigidity, with the shoots of O. loveni being weakest and those of D. pumila being strongest. (Rochester-IVI)
W86-00722

NUTRIENT FLUXES IN EUTROPHIC COASTAL LOUISIANA FRESHWATER LAKE,
Louisiana State Univ., Baton Rouge. Center for Wetland Resources.
C. A. Stow, R. D. De Laune, and W. H. Patrick, Jr.
Environmental Management, Vol. 9, No. 3, p 243-251, May, 1985. 12 Fig, 1 Tab, 19 Ref.

Descriptors: *Nutrients, *Eutrophic lakes, *Louisiana, *Lac des Allemands, Carbon, Nitrogen, Phosphorus, Sedimentation rates, Runoff, Cyanophyta, Water quality, Water pollution sources.

Nitrogen and phosphorus cycling in a eutrophic Louisiana freshwater lake system (Lac des Allemands) was studied. Nutrients from runoff entering the lake, as well as sediment-interstitial and lake water nitrogen and phosphorus fractions, were measured seasonally. Sedimentation rates in the lake were determined using Cs-137 dating. Phosphorus levels in the lake were found to be largely dependent on concentrations in the incoming bayou water from upland drainage. Lake water concentrations appear to respond to fluctuations in incoming waters. Laboratory equilibrium studies showed bottom sediments in the lake are a major sink for the incoming dissolved orthophosphate phosphorus. Total nitrogen concentrations in the lake water generally exceeded incoming runoff concentrations, suggesting fixation by the large blue-green algae population in the lake as being the major source of nitrogen to the system. Sedimentation ranged from 0.44 cm/year to 0.81 cm/year, depending on the proximity to the inlet bayous. Even though the lake is eutrophic the sediment served as a buffer by removing large amounts of carbon, nitrogen, and phosphorus through sedimentation processes. Carbon, nitrogen, and phosphorus were accumulating in the sediment at rates of 60, 7.1, and 1.1 g/sq m/year, respectively. The water quality of the lake is likely to continue to decline unless measures are taken to reduce municipal, industrial, and agricultural inputs of phosphorus into the lake. (Author's abstract)
W86-00724

TRACE-METAL CONCENTRATIONS IN SEDIMENTS FROM TWO CLOSED-BASIN LAKES, ANTARCTICA,
New Hampshire Univ., Durham. Dept. of Earth Sciences.
W. B. Lyons, P. A. Mayewski, and F. H. Chormann, Jr.
Chemical Geology, Vol. 48, No. 1/4, p 265-270, March, 1985. 2 Fig, 1 Tab, 32 Ref. NSF grant DPP-79-0755.

Descriptors: *Antarctic, *Trace metals, *Lake sediments, Polar regions, Iron, Manganese, Copper, Lead, Zinc, Water pollution sources, Groundwater, Calcium chloride, Brines, Don Juan Pond, Shea Sisters Lake.

Sediment trace-metal data were collected from two closed-basin lakes in Antarctica where no macro-organism disturbance of the historic record has taken place due to the harsh environment. Don Juan Pond is located in the western end of one of the major ice-free valleys, in southern Victoria Land. Shea Sisters Lake is an internally drained water body located in an ice-free portion at the southeastern end of the Morozimi Range. Sediment samples were analyzed for 25% HCl leachable Fe, Mn, Cu, Pb, Zn. The data were normalized to 100% silt-clay. The Pb concentrations in the sediment of Don Juan Pond were extremely low, indicating Pb remobilization from these sediments by CaCl2-rich brines. This process may have a profound effect on the evolution of groundwater in the ice-free valleys of Antarctica. A possible surficial enrichment of Pb was observed in Shea Sisters Lake samples from northern Victoria Land. This suggests that this area of Antarctica may have been affected by worldwide fossil fuel burning. (Moore-IVI)
W86-00770

CHEMICAL COMPOSITION OF RIVER SEDIMENTS FROM THE INDIAN SUB-CONTINENT,
Jawaharlal Nehru Univ., New Delhi (India). School of Environmental Sciences.
For primary bibliographic entry see Field 2J.
W86-00771

MATHEMATICAL MODEL FOR ANALYSIS OF SEDIMENT CORE DATA: IMPLICATIONS FOR ENRICHMENT FACTOR CALCULATIONS AND TRACE-METAL TRANSPORT MECHANISMS,
Freshwater Biological Association, Ambleside (England).
For primary bibliographic entry see Field 5B.
W86-00772

USE OF SEEPAGE METERS TO ESTIMATE GROUNDWATER NUTRIENT LOADING TO LAKES,
Florida Inst. of Tech., Melbourne. Dept. of Environmental Sciences and Engineering.
For primary bibliographic entry see Field 7B.
W86-00788

BOTTOMLAND VEGETATION DISTRIBUTION ALONG PASSAGE CREEK, VIRGINIA, IN RELATION TO FLUVIAL LANDFORMS,
Geological Survey, Reston, VA.
C. R. Hupp, and W. R. Osterkamp.
Ecology, Vol. 66, No. 3, p 670-681, June, 1985. 6 Fig, 4 Tab, 59 ref.

Descriptors: *Passage Creek, *Virginia, *Terrain analysis, *Vegetation, *Bottomlands, Channel morphology, Statistical analysis, Floodplains, Flooding, Riparian vegetation.

Persistent distribution patterns of woody vegetation within the bottomland forest of Passage Creek, Virginia, were related to fluvial landforms, channel geometry, streamflow characteristics, and sediment-size characteristics. Vegetation patterns were determined from species presence as observed in transects and traverses on landforms developed along the stream. Distinct species distributional patterns were found on four common fluvial geomorphic landforms: depositional bar, active-channel shelf, floodplain, and terrace. Independent hydrologic characteristics (flow duration and flood frequency) were determined for each of the landforms. Vegetation data were analyzed by binary discriminant analysis, principal components analysis, and detrended correspondence analysis. Results and related field observations suggest that certain species are significantly associated with specific fluvial landforms. Vegetation patterns appear to develop more as a result of hydrologic processes associated with each fluvial landform rather than from sediment-size characteristics. Flood disturbance may be an important factor in maintaining the vegetation patterns, which may therefore be used as indicators for particular hydrogeomorphic site conditions. (Author's abstract)
W86-00826

HISTORICAL CHANGES IN SUBMERGED MACROPHYTE COMMUNITIES OF UPPER CHESAPEAKE BAY,
California Univ., Santa Barbara. Dept. of Geography.
F. W. Davis.
Ecology, Vol. 66, No. 3, p 981-993, June, 1985. 7 Fig, 5 Tab, 65 Ref.

Descriptors: *Aquatic plants, *Chesapeake Bay, *Seeds, *Sediment cores, *History, Eutrophication, Water pollution effects, Macrophytes, Aquatic weeds, Elodea, Land use, Vallisneria, Najas, Myriophyllum.

Submerged macrophyte species that occurred at the head of Chesapeake Bay over the past 1800 yr have been documented by analyzing seed assemblages in sediments from a tidal embayment. To help interpret seed stratigraphy in the estuary, seed settling behavior was studied in the laboratory, and the relationship between parent vegetation and resulting sedimentary seed assemblages was studied in a tidal creek. Results suggest that estuarine seed assemblages are primarily locally derived and have high spatial variability, and that because of differences in seed output or preservation some species are overrepresented in the seed record. Seed assemblages in four cores from the estuary are accordingly treated as presence/absence data. The record of local submerged macrophytes was profiled in 7-100 yr intervals, using sediment dates obtained radiometrically and by pollen stratigraphy. Vallisneria americana, Najas flexilis, N. gracillima, and Elodea canadensis were consistently present for 1500-1600 yr prior to colonization by Europeans (1730 AD), while N. guadelupensis appeared 300-400 yr prior to European settlement. Vallisneria americana was the only local species continuously present for 150 yr following initial deforestation. After 1930, N. guadalupensis and N. flexilis appeared more regularly in the record, and two local expansions of Myriophyllum spicatum were registered. Native submerged aquatic vegetation disappeared from the area between 1964 and 1972, and has shown little recovery since that time. Community changes after 1930 appear to be related to increased eutrophication. (Author's abstract)
W86-00828

RELATIONSHIPS BETWEEN SURFACE SEDIMENT DIATOM ASSEMBLAGES AND LAKEWATER CHARACTERISTICS IN ADIRONDACK LAKES,
Indiana Univ. at Bloomington. Dept. of Biology.
D. F. Charles.
Ecology, Vol. 66, No. 3, p 994-1011, June, 1985. 11 Fig, 5 Tab, 71 Ref. NSF grant DEB 77-03907 and DEB 79-12210.

Descriptors: *Lake sediments, *Diatoms, *Adirondack Mountains, *New York, *Water quality, *Species composition, Hydrogen ion concentration, Acid lakes, Ecological effects, Mountain lakes, Elevation, Water temperature, Sulfuric acid, Chlorine, Silicone, Phosphorus, Chlorophyll a, Acidity.

Relationships between surface sediment diatom assemblages and lakewater characteristics were studied in 38 lakes in the Adirondack Mountains of northern New York. Most of the lakes are dilute, poorly buffered, and oligotrophic to mesotrophic. The diatom flora (240 taxa identified) is typical for circumneutral to acidic lakes. The purposes of this study were to identify the environmental factors most strongly related to the distributions of diatom taxa and the overall composition of diatom assemblages, and to derive equations to infer lakewater pH from diatom assemblage data. Relationships between diatom assemblages and environmental gradients were analyzed using reciprocal averaging ordination (RA). Correlations between RA axis 1 and pH-related factors were strong (pH, r squared = 0.90; alkalinity, r squared = 0.81; p(Ca positive charges), r squared = 0.67; pMg, r squared = 0.78; pNa, r squared = 0.48; p-total Al, r squared = 0.58; conductivity, r squared = 0.47). Correlations were weaker (but still statistically significant) with elevation, epilimnion temperature, and concentrations of SO4, Cl, and Si. Total P, chlorophyll a, water color, and mean depth were not important in explaining differences among assemblages. Cluster analysis of lakes and diatom taxa, multiple regression of taxon cluster groups with lakewater pH, and the occurrence patterns of individual taxa also indicated that pH-related factors are closely associated with diatom distribu-

tions. Euplanktonic taxa were present only rarely in surface sediments of lakes having a pH < 5.8, alkalinity < 20 micro-mol/L, and concentrations of Ca positive charges < 100 micro-mol/L and total Al > 60 micro-g/L. Predictive equations were derived for inferring lakewater pH from diatom assemblage data. Most were based on approaches of Hustedt (1939), Nygaard (1956), Merilainen (1967), and Renberg and Hellberg (1982). Agreement between predicted and measured pH was very good; r squared values ranges from 0.61 to 0.94 and SE from 0.28 to 0.60 pH units. These predictive relationships can be used to interpret stratigraphic diatom assemblages to reconstruct lake pH histories. No significant relationships existed between Araphidinae:Centrales ratios and measures of trophic status. (Author's abstract)
W86-00829

PHOSPHORUS SPIRALLING IN A WOODLAND STREAM: SEASONAL VARIATIONS,
Oak Ridge National Lab., TN. Environmental Sciences Div.
P. J. Mulholland, J. D. Newbold, J. W. Elwood, L. A. Ferren, and J. R. Webster.
Ecology, Vol. 66, No. 3, p 1012-1023, June, 1985. 4 Fig, 5 Tab, 43 Ref. U.S. DOE contract DE-AC05-840R21400.

Descriptors: *Nutrient spiralling, *Phosphorus radioisotopes, *Cycling nutrients, *Seasonal variation, *Walker Branch, *Tennessee, Radioisotopes, Spiralling length, Particulates, Organic matter.

Four radiotracer releases were performed over an annual period in 1981-1982 to determine seasonal variation in indices and pathways of phosphorus spiralling in Walker Branch, a small woodland stream in eastern Tennessee, USA. Each release consisted of an addition of approximately 370 MBq each of carrier-free labeled PO4 and labeled H2O over a 1-h period during baseflow. Concentrations of P-32 and H-3 dissolved in stream water were measured intensively at several stations downstream from the radiotracer input during and immediately following each release. Activity of P-32 in coarse particulate organic matter (CPOM), fine particulate organic matter (FPOM), and aufwuchs was measured 2-3 h after each release and at various intervals for 7 wk. Total biomass of CPOM, FPOM, and aufwuchs at the time of each release was also measured. Uptake of labeled PO4 from the water was greatest in November and lowest in August. Uptake length (Sw) of phosphorus, defined as the average distance travelled by a PO4 ion dissolved in water, varied from 22 m in November to 97 m in August. Uptake of PO4 by CPOM was generally greatest, with approximately 50% of total uptake, while that by aufwuchs was lowest, with < 15% of the total. CPOM abundance was the major determinant of whole-stream PO4 uptake rate and Sw. Turnover length (Sp) of phosphorus, defined as the average distance traveled by an atom of P taken up by particulate material, was short compared to Sw varying from 1 m in November to 3 m in January. Consequently total spiralling length (S) of P varied from 23 m November, just after peak autumn leaf fall, to 99 m in August, and reflected primarily the travel of P in the dissolved form. Our results indicate that the greatest increase in Sw (and consequently in S) in Walker Branch occurs in late autumn or winter after storms reduce the abundance of CPOM in the lower portions of the stream bed. Although we calculate that Sp may increase by one to two orders of magnitude for short periods during storms, the greatest effect of storms on P spiralling over the long term is their impact on the quality and quantity of CPOM and FPOM in the stream bed after the return to baseflow. For most of the year, detrital organic carbon probably influences phosphorus spiralling more than phosphorus spiralling influences the processing of organic carbon in Walker Branch. Only during the fall and early winter periods, when CPOM abundance is high and Sw is short, does phosphorus spiralling exert strong control over biotic processes downstream. (Author's abstract)
W86-00830

NITROGEN TRANSFORMATIONS AND LOSS IN FLOODED SOILS AND SEDIMENTS,
Agricultural Research and Education Center, Sanford, FL.
For primary bibliographic entry see Field 2K.
W86-00849

LAKE MODELING: STATE OF THE ART,
R. H. French.
CRC Critical Reviews in Environmental Control, Vol. 13, No. 4, p 311-357. 6 Fig, 10 Tab, 146 Ref.

Descriptors: *Lake modeling, *Limnology, *Reservoirs, *Model studies, Hydrodynamics, Cycling nutrients, Phosphorus, Steady-state models, Nitrogen, Limiting nutrients.

Modeling of hydrodynamics and chemical and biological processes in surface water impoundments (ie, natural lakes and man-made reservoirs) is reviewed. Basic concepts of one-, two-, and three-dimensional hydrodynamic models are available now that they are conceptually correct, numerically efficient, reasonably accurate when used correctly, and relatively well documented. Research models typically incorporate the most modern methods, but have inadequate documentation and have not been sufficiently tested. Applied models may not employ state-of-the-art methods, but are well documented and have been comprehensively tested. The latter are to be preferred. Impoundment modeling is further advanced in the area of hydrodynamics than in the areas of chemical and biological processes. Additional research is needed regarding the linkage among hydrodynamic, chemical, and biological processes. The flux of nutrients across the sediment interface cannot be accurately simulated without site-specific studies. Steady-state loading and biomass models, when properly employed, can provide cost-effective results which complement the results that can be obtained from dynamic water quality models. These two types of models should be used together in design of impoundment restoration programs. The limits of coefficient validity in steady-state models need to be further denied. Although most impoundments studied to date appear to have been phosphorus-limited, there exist a significant number of nitrogen-limited impoundments. (Rochester-IVI)
W86-00850

SOME MIRE SYSTEMS IN JAPAN,
Aberdeen Univ. (Scotland). Dept. of Botany.
C. H. Gimingham.
Transactions of the Botanical Society of Edinburgh, Vol. 44, No. 3, p 169-176, 1984. 1 Fig, 2 Ref.

Descriptors: *Japan, *Mires, *Peat bogs, *Wetlands, Ecosystems, Vegetation, Habitats, Conservation.

Some examples of different types of mires in Japan are described and compared with their European counterparts. The parallels in ecosystem development and vegetation physiognomy with mires in equivalent habitats in Europe are striking. Numerous species are common to both, in other cases closely related species fill similar niches. In some instances, however, a given species displays marked ecological differences in the two regions. The flood plain mires of Hokkaido and the mires of Oze and Kirigamine are among the finest examples of their kind in the world. Those in the mountain districts are adequately protected in National Parks: it is suggested that the lowland mires of Hokkaido require further protection. (Author's abstract)
W86-00904

LIMNOLOGY AND MACROPHYTE VEGETATION OF A DEEP, CLEAR LIMESTONE LAKE, LOCH BORRALIE,
Saint Andrews Univ. (Scotland). Dept. of Plant Biology and Ecology.
D. H. N. Spence, A. M. Barclay, and E. D. Allen.
Transactions of the Botanical Society of Edinburgh, Vol. 44, No. 3, p 187-204, 1984. 4 Fig, 3 Tab, 26 Ref.

Descriptors: *Loch Borralie, *Scotland, *Limnology, *Macrophytes, Nutrients, Interstitial water, Aquatic plants, Lakes, Limestone lakes.

A bathymetric survey shows Loch Borralie (Scotland) to have a maximum depth of 36 m. It is one of the most transparent lakes in Britain and is unstratified and poor in nutrients and phytoplankton, although the interstitial water of its calcareous muds is rich in nitrogen and phosphorus. Forty-four percent of the loch surface is densely colonized by macrophytes. The littoral to 2 m bears very sparse Chara aspera var. lacustris and the zone from 2 to 4.5 m is dominated by tall Hippuris vulgaris, Myriophyllum spicatum and four Potamogeton spp., for which Chara and Nitella (principally C. globularis and N. flexilis) form an understorey. Three Potamogeton species persist to 6.5 m in an undulating Chara-Nitella 'meadow' which continues, alone, to between 12 and 15 m depth. Loch Borralie is the most deeply and possibly the most extensively colonized lake in the United Kingdom. (Author's abstract)
W86-00905

AQUATIC ANGIOSPERM COMMUNITIES FROM LOCHS ON RHUM,
Saint Andrews Univ. (Scotland). Dept. of Botany.
A. M. Farmer.
Transactions of the Botanical Society of Edinburgh, Vol. 44, No. 3, p 229-236, 1984. 1 Fig, 1 Tab, 15 Ref.

Descriptors: *Lochs, *Aquatic plants, *Macrophytes, *Rhum, *Scotland, Lakes, Ponds, Lochans, Exposure, Substrate.

The aquatic angiosperm communities from twenty lochs and lochans on the island of Rhum National Nature Reserve (Scotland) were surveyed. The sites are mostly located around the major lochs of the central part of Rhum, but a small number of more widely distributed lochs are also included so that local differences in vegetation may be noted. Species lists are given for each site. The vegetation in the study sites is comparable to those of poorer lochs surveyed in other parts of Western Scotland. Aquatic vegetational cover is sparse and only a limited number of plant communities are present, predominantly those involving Lobelia dortmanna and Littorella uniflora as dominants or co-dominants, and a more restricted representation of communities with Equisetum fluviatile, Phragmites australis or Nymphaea alba subsp. alba. Exposure and poor substratum are suggested as factors causing limited plant growth. The littoral zones of many lochs are strewn with large rocks, which not only restrict plant growth but create further turbulence. Only in a few of the larger lochs, with sheltered bays and deeper water, are there varying plant communties. (Moore-IVI)
W86-00906

DYNAMICS OF THE STRUCTURE OF THE ICHTHYOCENOSIS OF LAKE UBINSKOYE,
R. I. Setsko, and L. I. Tereshchenko.
Journal of Ichthyology, Vol. 24, No. 5, p 71-77, 1984. 2 Fig, 2 Tab, 15 Ref.

Descriptors: *Ichthyocenosis, *Lake Ubinskoye, *USSR, *Lake fisheries, Fisheries, Fish populations, Fish harvest, Population dynamics, Water level, Species composition.

The factors controlling the structure of the ichthyocenosis of Lake Ubinskoye, western Siberia (USSR) were analyzed based on records of lake levels and commercial catches from 1930-1981, original data, and published results. Lake Ubinskoye has a surface area of 50,000 hectares and an average depth of 2.14 m, so that slight fluctuations in lake level produce considerable changes in area and volumes of the lake. During the past 40-50 yr, the ichthyocenosis of the lake has been experiencing intensified pressure from external influences: changes in lake level and exploitation until 1952, changing lake level regime, exploitation, and sudden appearance of the acclimatized bream after 1952, and since 1968, changes in lake level regime, exploitation, winter kill, introduction of peled, and reacclimatization of bream after winter kill. Three trends in qualitative transformation of the ichthyocenosis are apparent: (1) change in the number of basic (commercial) species, which are character-

ized by the complexity index (H sub m = log base 2 n, where n = the number of species in the commercial catch), (2) replacement of some basic species by others, without any change in the overall total, which is characterized by the index for the degree of species similarity (a modification of the Sorensen index, K = c/a x 100%, where c = the number of species common to two lists being compared and a = the number of species in one of the lists of interest), and (3) redistribution of the species in the overall biomass, a parameter indicated by the 'entropy' (H = sum of p sub i log base 2 p sub i, where p sub i is the share of the species in the general biomass) and 'relative organization' (R = 1 - H/H sub m). The redistribution of stock of different species into the general biomass is a constantly active mechanism regulating the structure of the ichthyocenosis; only when regulation at this level becomes no longer possible do mechanisms of profound changeovers come into play. (Rochester-IVI)
W86-00912

ORGANIC MATTER IN GRAVEL STREAMS (PROJECT RITRODAT-LUNZ),
Biological Station, Lunz am See (Austria).
M. Leichtfried.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, No. 4, p 2058-2062, 1985. 9 Fig, 13 Ref.

Descriptors: *Benthos, *Organic matter, *Gravel streams, *Particle size, Bacteria, Fungi, Particulate matter, Stream sediments, Sediments.

In gravel streams in mountainous areas, the energy basis is nearly exclusively allochthonous organic matter, mainly particulate organic matter (POM) from soil erosion and aerial drift. The main energy pathway connects POM over the microbenthos (fungi and bacteria) with the so-called detritivorous animals (more appropriately called pomivorous animals). Pomivorous animals prefer particles colonized by fungi and bacteria as food. This study concentrates on bed sediments, and their surfaces suitable for colonization by bacteria and fungi. The relative percentage of sediment grains smaller than 1 mm increases with sediment depth, but rarely exceeds 10%. POM concentrations decrease rapidly with increasing grain size. POM concentrations are always high in the grain size-class 0.5 to 1 mm, making this size class most valuable for pomivorous animals. In any stream-ecosystem analysis, the amount of bed sediment-surface suitable for colonization by the microbenthos is a main parameter, not to be overlooked. (Moore-IVI)
W86-00913

EFFECT OF DROUGHTS ON THE INVERTEBRATE COMMUNITIES OF HIGH MOUNTAIN STREAMS,
Polish Academy of Sciences, Krakow. Zaklad Biologii Wod.
A. Kownacki.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, No. 4, p 2069-2072, 1985. 5 Fig, 1 Ref.

Descriptors: *Invertebrates, *Droughts, *Poland, Seasonal variation, Streams, Stream biota, Mayflies.

Studies of the invertebrate fauna of the high mountain stream Sucha Woda (High Tatra Mountains, Poland) indicate that droughts or winter freezing are important causes behind the development of a specific fauna in the kryon zone. Two stations were sampled: station 1, at 1,600 m, was below the outflow of Lake Czarny Staw Gasienicowy, and had water flowing for 5-7 mo following the beginning of snow melt (May, June) and station 2, at 1,000 m altitude, was below the sector of the permanent stream, and had water flowing from the time of snow melt until August in dry years or until the beginning of winter in wet years. When the streams begin to flow, two periods of faunal development can be distinguished. In the first period, autochthonous elements, adapted to surviving drought, dominate (Prosimulium and Diamesa latitarsis at station 1 and Eukiefferiella cyanea (riffle) Parametriocnemus borealpinus (pool) at station 2). In the second period, the dominant elements are those that migrate from other places either by downstream drift (station 2 only) or aerially (both stations). In the summer drift, mayflies (Baetis alpinus) are most important. In a temporary stream situated below a sector of permanent stream, the fauna adapted to life in temporary streams exists only for a relatively short period, and is soon replaced by a fauna typical of permanent streams whose representatives are better adapted to living in the stream. On the other hand, at higher altitudes, the opportunity is much smaller for the fauna of permanent streams to inhabit a given reach of stream, and occurs, though not always, by the end of the growing season. Thus, species characteristic of temporary streams remain for most or all of the season. (Rochester-IVI)
W86-00915

CHEMICAL-PHYSICAL CHANGES ASSOCIATED WITH ENVIRONMENTAL GRADIENTS IN THE OKA RIVER BASIN,
E. Orive, and I. Arteaga.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, No. 4, p 2073-2076, 1985. 3 Fig, 5 Ref.

Descriptors: *Oka River basin, *Spain, *Physicochemical characteristics, *Environmental gradient, *Biotic index, Geochemistry, Water temperature, Conductivity, Alkalinity, Hydrogen ion concentration, Oxygen, Nutrients, Phosphates, Nitrates, Nitrites, Chloride, Benthos, Macroinvertebrates, Cluster analysis, Principle components analysis, Statistical analysis.

Physical and chemical parameters and biotic index (Tuffery and Verneaux) data, when subjected to multivariate analyses, defined differences among sampling sites in the Oka River basin (North Spain) that appeared to be related principally to geologic substrate and distance from the headwaters. At each of 124 stations, temperature, conductivity, alkalinity, pH, oxygen, nutrients (phosphate, nitrate, and nitrite), and chloride were measured and benthic macroinvertebrates were collected. Longitudinal trends of the main variables were examined by principal components analysis and cluster analysis. The influences of sewage effluents, chloride from sea spray, and changes in conductivity resulting from the change from non-calcareous (basalt and sandstone) to calcareous (principally chalk) substrates were apparent in the data. The biotic index indicated environmental stress in the lower reaches of the basin. Cluster analysis separated the stations into groups among which the differences were determined mainly by their distance from sea level. (Rochester-IVI)
W86-00916

PATTERNS OF MACROINVERTEBRATE DISTRIBUTION IN THE LLOBREGAT RIVER BASIN (NE SPAIN),
Barcelona Univ. (Spain). Dept. de Ecologia.
G. Gonzalez, X. Millet, N. Prat, and M. A. Puig.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, No. 4, p 2081-2086, 1985. 3 Fig, 1 Tab, 7 Ref.

Descriptors: *Macroinvertebrates, *Spatial distribution, *Species composition, *Llobregat River Basin, *Spain, Streams, Rivers, Ecological distribution, Aquatic insects, Water pollution effects.

Patterns of macroinvertebrate (mainly insect) distributions in the Llobregat River drainage (northeastern Spain) showed that there were five groups (mountain stream species, stream species, small stream species, riverine species, and special distributions). Sampling was conducted at 74 sites, which were visited in September and December 1979 and April and August 1980. The mountain species group had a reduced distribution, with high percentage abundances in the upper reaches. The stream species group had a distribution throughout the entire upper basin, with the highest percentage values in the Llobregat main channel. The small stream group was distributed in all the lateral small channels of the basin, with the highest percentage values in the small streams; the only difference separating this group from the stream species was the lower order of streams it occupied. The riverine species had the widest distribution observed, and were found either in lateral small streams or in the main channel, although the highest percentage values were found in the lower reaches of the main channel. Special distributions included some species that did not fit the other patterns. These included species that appeared to be restricted due to salinity, occurrence in springs, or for no apparent reason. Generally, the five groups showed successively greater overlap proceeding from the restricted distribution of the upper reaches toward the wider distributions of the lower zones. This reflects increasing uniformity of habitat in the downstream direction, which is produced by the hierarchical structure of the river basin and the pollution of the main channel. (Rochester-IVI)
W86-00917

VARIATIONS IN THE AMOUNT OF ORGANIC CARBON (DISSOLVED AND PARTICULATE) IN A SMALL MEDITERRANEAN MOUNTAIN STREAM (CORSICA) (LES VARIATIONS DES TENEURS EN CARBONE ORGANIQUE (DISSOUS ET PARTICULAIRE) D'UN PETIT TORRENT MEDITERRANEEN MONTAGNARD (CORSE)),
Ecole Normale Superieure, Paris (France). Lab. de Geologie.
M.-D. Loye-Pilot.
Verhandlung Internationale Vereinigung Limnology, Vol. 22, No. 4, p 2087-2093, 1985. 1 Tab, 10 Ref.

Descriptors: *Organic carbon, *Mountain streams, *Dissolved solids, *Particulate matter, *Corsica, *France, Flow discharge, Storms, Streams, Throughfall, Soil water, Forest watersheds, Soil erosion.

Dissolved and particulate (< 1 mm) organic carbon was measured during 2 years in a small mountain stream in a pristine forested mediterranean area (Corsica). The dissolved organic carbon (DOC) values range from 0.5 to 8.1 mg/l, those of the particulate organic carbon (POC) from 0.09 to 10.3 mg/l. The DOC/POC ratio fluctuates from 0.3 to 28, but generally DOC is far greater than POC. There is no correlation between DOC, POC, TOC (total organic carbon) and water discharge, but each storm event presents a DOC and POC increase with discharge, with various patterns of DOC, POC at discharge peaks. DOC during low-flow stage in summer and in-between storm events is close to the groundwater values (0.4-0.5 mg/l). DOC increases when throughfall and/or soil water reach the stream channel. The POC peak appears just before or during the rising limb of the hydrograph, or at the discharge peak. POC peak duration is generally very short; thus peak sampling is necessary for export computing. The removal rate of the POC stored in the channel and the soil erosion rate determine the export pattern of POC. DOC and POC variations depend on the storm events and, for each storm, on the recent hydroclimatic 'history' of the watershed. (Author's abstract)
W86-00918

ABIOTIC AND HYDROBIOLOGIC CHARACTERISTICS OF THE MEDITERRANEAN RUNNING WATERS (CARACTERISTIQUES ABIOTIQUES AND HYDROBIOLOGIQUES DES EAUX COURANTES MEDITERRANEENNES),
Aix-Marseille-3 Univ. (France). Faculte des Sciences et Techniques.
J. Giudicelli, M. Dakki, and A. Dia.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, Part 4, p 2094-2101, March, 1985. 1 Fig, 1 Tab, 12 Ref.

Descriptors: *Hydrology, *Lotic environment, *Mediterranean basin, *Aquatic animals, Running waters, Hydrobiology, Climate, Altitude, Precipitation, Distribution, Water temperature, Ecosystems.

The permanent Mediterranean watercourses have a regime characterized by irregularity of flow and by extreme hydrologic conditions. Precipitation is concentrated in short periods. Variations in thermal regime are also extreme. Studies were con-

ducted on four river systems in different parts of the Mediterranean basin to determine the principal characteristics of Mediterranean lotic ecosystems. The fauna is rich in endemics and is composed of a number of autochthonous lines which are unique to the ecosystems. The biocenotic analysis indicates that there is a notable longitudinal zonation; the zonation is generally compressed. In the eastern Mediterranean islands, there is no longitudinal zonation due to the low output of the streams. Both thermal and altitudinal influences are evident. (Moore-IVI)
W86-00919

2I. Water In Plants

SEASONAL AND DIURNAL WATER RELATIONS ADJUSTMENTS IN THREE EVERGREEN CHAPARRAL SHRUBS,
San Diego State Univ., CA. Systems Ecology Research Group.
W. D. Bowman, and S. W. Roberts.
Ecology, Vol. 66, No. 3, p 738-742, June, 1985. 3 Fig, 25 Ref. NSF grant DEB 80-25977.

Descriptors: *Seasonal variation, *Chaparral, *Diurnal distribution, *Plant water potential, Water potentials, Oak, Bearberry, Ceanothus, Pressure-volume approach, Turgidity, Water stress.

Pressure-volume curves were measured in three co-occurring chaparral shrubs, Arctostaphylos glandulosa, Quercus dumosa, and Ceanothus greggii, during a seasonal drought cycle. The pressure-volume approach was used to quantify diurnal and seasonal changes in plant water relations. Field measurements of plant water potentials and microclimate were also made to relate the pressure-volume results to the field setting. The seasonal trend was toward increasingly negative osmotic potentials with little (Q. dumosa) or no (A. glandulosa and C. greggii) recovery following the end of the drought. Shifts in the turgor loss point occurred both seasonally and diurnally. The larges diurnal shifts occurred during periods of maximum air temperature and minimum soil water potential. Concurrent field measurements of water potential indicate that these shifts were necessary for preventing turgor loss during periods of midday water stress in Q. dumosa and C. greggii. The shrubs differed in their mode of seasonal osmotic adjustment. Ceanothus greggii accomplished changes in osmotic potential by variation in the osmotic water volume; the other two shrubs appeared to accomplish such changes largely by solute variation while maintaining relatively constant osmotic water volumes. (Author's abstract)
W86-00827

EFFECT OF FLOODING OF SOIL ON GROWTH AND SUBSEQUENT RESPONSES OF TAXODIUM DISTICHUM SEEDLINGS TO SO2,
Wisconsin Univ.-Madison. Dept. of Forestry.
For primary bibliographic entry see Field 5C.
W86-00861

EFFECT OF DROUGHT ON METABOLISM AND PARTITIONING OF CARBON IN TWO WHEAT VARIETIES DIFFERING IN DROUGHT-TOLERANCE,
Melbourne Univ., Parkville (Australia). Plant Sciences Section.
M. E. Nicolas, H. Lambers, R. J. Simpson, and M. J. Dalling.
Annals of Botany, Vol. 55, No. 5, p 727-742, May, 1985. 8 Fig, 4 Tab, 24 Ref.

Descriptors: *Drought resistance, *Partitioning, *Metabolism, *Carbon, *Wheat, Moisture deficiency, Drought, Plant physiology, Crop yield, Roots, Leaves, Osmotic pressure.

A model was constructed to describe the partitioning of carbon on the third and seventh day from anthesis for well-watered and droughted plants of two wheat varieties (Triticum aestivum L. cv. Warigal and Condor). The glasshouse-grown plants were detillered so that a simplified model could be derived for the main stem. The 9-d drought treatment, imposed just after anthesis during the period of cell division in the grains, reduced grain yield by 18% in Warigal and 30% in Condor. Net carbon fixation was up to 60% higher in Warigal than Condor towards the end of the drought period and this correlated with better osmotic adjustment in the flag leaf. Carbon partitioning between plant organs responded to water deficit more rapidly than net carbon fixation. On day 3, carbon allocation of the roots of droughted plants was maintained in Condor and increased by 14% in Warigal, whereas carbon allocation to the ear decreased in both varieties. However the roots did not compete well with the ear when the water deficit became more severe. Warigal accumulated 3 times more stem reserves that Condor under drought. In the roots, the pattern of carbon allocation between respiration and carbon accumulation changed soon after imposition of drought. Although total root respiration decreased under drought it became more energy efficient, particularly for Warigal, as less respiration took place via the alternative pathway. On day 3, the larger carbon allocation to the roots and the lower root respiration accounted for the 4-times larger sugar accumulation in droughted roots of Warigal compared with those of Condor. Osmotic adjustment in mature leaves and roots may be of importance for the maintenance of vital processes and for recovery after drought. (Author's abstract)
W86-00907

EFFECTS OF DROUGHT ON PARTITIONING OF NITROGEN IN TWO WHEAT VARIETIES DIFFERING IN DROUGHT-TOLERANCE,
Melbourne Univ., Parkville (Australia). Plant Sciences Section.
M. E. Nicolas, R. J. Simpson, H. Lambers, and M. D. Dalling.
Annals of Botany, Vol. 55, No. 5, p 743-754, May, 1985. 3 Fig, 3 Tab, 13 Ref.

Descriptors: *Drought tolerance, *Nitrogen, *Partitioning, *Wheat, Moisture deficiency, Crop yield, Leaves, Stem, Roots, Translocation.

A model was constructed to describe the translocation and partitioning of nitrogen on the seventh day after anthesis for well-watered and droughted plants of two wheat varieties (Triticum aestivum L. cv. Warigal and Condor). The glasshouse-grown plants were detillered so that a simplified model could be derived for the main stem. A 9-d drought treatment was imposed just after anthesis and this coincided with the period of endosperm cell division in the grains. Warigal, which had a higher grain yield than Condor under drought, absorbed up to 15-times more nitrogen and translocated 1.5-fold more nitrogen to the shoot via the xylem. In both varieties, nitrogen redistributed from vegetative organs accounted for more than 60% in control and 70% in droughted plants of the nitrogen needed for ear growth. The net loss of nitrogen increased by 4.3% in the leaves, but decreased by 60% in the stem under drought. Stem and roots appeared to play an important role in the nitrogen economy of droughted plants: less nitrogen was translocated directly to the grains from the senescing leaves and 40-60% more nitrogen was translocated to the roots. Nearly all the nitrogen reaching the roots in the phloem was reloaded into the xylem stream and translocated back to the shoot. The transfer of nitrogen through the stem was reduced under drought and this resulted in a constant C:N ratio of the grains which may be important in the regulation of endosperm cell division. (Author's abstract)
W86-00908

2J. Erosion and Sedimentation

ACCUMULATION OF SEDIMENT ORGANIC MATTER IN A HARDWATER LAKE WITH REFERENCE TO LAKE ONTOGENY,
University of Southern Mississippi, Hattiesburg. Dept. of Biological Sciences.
G. L. Godshalk, and R. G. Wetzel.
Bulletin of Marine Science, Vol. 35, No. 3, p 576-586, November, 1984. 5 Fig, 4 Tab, 33 Ref. DOE grants EY-75-S-02-1599 and COO-1599-243, Waterways Experiment Station grant DACW-39-82-M-1666.

Descriptors: *Organic matter, *Lake sediments, *Lake ontogeny, Detritus, Hardness, Primary productivity, Plant growth, Water depth, Sediment erosion, Sedimentation, Particulate matter, Limnology.

The occurrence and quality of detrital organic matter was investigated in sediments of a small hardwater lake. The objective of the study was to examine the interactions between plant productivity and growth form, water depth, sediment depth and potential erosion and deposition processes in the lake and their mutual impact on accumulation of detritus in the sediments. Of particular interest are the potential effects such accumulation has on sediment dynamics and lake ontogeny. Sediment core samples were taken on a transect from the water's edge to the deepest part of the lake. Samples of surficial, intermediate and deep sediments from all water depths were analyzed for content of coarse particulate matter, organic matter, solvent-extractable humins and fulvic and humic acids. Sediments at the surface in very shallow water, sediments of intermediate depth in the deep littoral zone, and sediments at all depths in the deepest waters contained the greatest concentrations of organic matter. Furthermore, those organic compounds were shown by spectrophotometric characterization to be old and probably very refractory. The observed occurrence of sedimentary detrital carbon is explained in terms of hypothesized synergistic effects of increasing production and succession of littoral vegetation, differential decomposition rates controlled by properties of both the substrate and the microenvironment and the influence of water movements and basin morphology on sediment erosion and deposition. (Author's abstract)
W86-00643

CHEMICAL COMPOSITION OF RIVER SEDIMENTS FROM THE INDIAN SUB-CONTINENT,
Jawaharlal Nehru Univ., New Delhi (India). School of Environmental Sciences.
V. Subramanian, L. Van 't Dack, and R. Van Grieken.
Chemical Geology, Vol. 48, No. 1/4, p 271-279, March, 1985. 3 Fig, 5 Tab, 16 Ref.

Descriptors: *River sediments, *Chemical composition, *Indian subcontinent, Sediments, Weathering, Watersheds, Geology, Catchment areas.

River sediments from all of the major drainage basins (except the Indus) in the Indian sub-continent were collected and analysed by thin-film X-ray fluorescence technique (XRF) to determine their chemical composition. On the basis of analysis of more than 120 samples, average chemical compositions of river-borne sediments from the Indian sub-continent have been calculated. Also, average concentration values for sediments from each of the river basins, and the sub-continent average and the inter-basin differences are discussed in relation to weathering processes in the drainage basins. Comparisons have been made with the chemistry of sediments from the Bay of Bengal (which receives the bulk of sediments delivered by Indian rivers). The observations are discussed in the light of average chemical composition of world-river sediments and the world surface rock exposed for continental weathering. (Author's abstract)
W86-00771

ECONOMICS OF EROSION CONTROL IN A SUBTROPICAL WASTERSHED: A DOMINICAN CASE,
Ohio State Univ., Columbus. Dept. of Agricultural Economics and Rural Sociology.
A. Veloz, D. Southgate, F. Hitzhusen, and R. Macgregor.
Land Economics, Vol. 61, No. 2, p 145-155, May, 1985. 5 Tab, 24 Ref.

Descriptors: *Erosion control, *Dominican Republic, *Soil conservation, *Developing countries, Economic aspects, Land development, Regional development, Public policy, Land use, Reservoir silting.

The economics of a soil conservation project for the watershed of the Valdesia hydroelectric dam, Dominican Republic, were analyzed in terms of private-level and social level costs and benefits, and the results interpreted in relation to the general problem of protecting soils in Third World countries. Land use and management were assumed to be guided by procedures judged by many specialists to be appropriate to the Dominican Republic; land was classified into four classes based on slope, with different procedures specified for each slope class. If the land managment guidelines were followed, it was estimated that the sedimentation rate (output) would drop 86%. It was calculated that a 25% reduction in erosion would extend the life of the hydroelectric project by 6 yr, from 19 to 25 yr. The private-level analyses have limited precision, but they indicate that some farmers would have little or no cost, and possibly some gain, from using land management measures. However, conversion of land from traditional agriculture to a more soil-conserving use does not seem to be in the private interest of many groups of farmers. Analysis of on-site impacts using a social accounting stance suggests that implementation of soil-conserving practices throughout the Valdesia reservoir catchment might satisfy the Hicks-Kaldor efficiency test. The conclusion that net social welfare would be improved by reducing erosion is reinforced by incorporating the external benefits of soil conservation into the evaluation. Lack of information, insecurity of land tenure, and currency valuation problems are among the factors accounting for lack of widespread adoption of soil conservation by people in this watershed. Ultimately, making a constructive change (including reduction of population growth) in the lives of the inhabitants of areas like the Valdesia watershed is probably the only way to contain environmental damage. (Rochester-IVI)
W86-00894

BANK-EROSION PROCESSES IN A COOL-TEMPERATE ENVIRONMENT, ORWELL LAKE, MINNESOTA,
North Dakota Univ., Grand Forks. Dept. of Geology.
J. R. Reid, Jr.
Geological Society of America Bulletin, Vol. 96, No. 6, p 781-792, June, 1985. 17 Fig, 4 Tab, 49 Ref.

Descriptors: *Bank erosion, *Orwell Lake, *Minnesota, Reservoirs, Sheet erosion, Mass wasting, Slope degradation, Thaw failure, Sublimation, Interstitial ice, Rain, Storms, Mudflows.

Orwell Lake, in west-central Minnesota, is a flood-control, water-management reservoir first impounded in 1953. Subsequent concern about erosion of the shoreline and a lack of knowledge of slope-erosion processes in this part of the upper Midwest prompted this study to identify and quantify the processes there. The processes were measured at selected sites between June 1980 and June 1983. Erosion of the banks is predominantly by thaw failure and secondarily by rainsplash and sheetwash. In winter, the upland surface adjacent to the lake freezes to a depth of between 1 and 2 m, depending on surface temperature, snow cover, and distance from exposed banks. In late winter, soil aggregates, released by the sublimation of interstitial ice within the banks, begin to accumulate at the base of the slopes, often veneering snowbanks. As soon as thaw begins, slab failure of bank sediment is followed by mudflows and earthflows. Thaw failure at Orwell Lake in the spring of 1982 accounted for 89% of the erosion (824 Mg); the following spring, 78% (746 Mg). Such slope failure is most intense along north-facing banks and considerably less intense on south-facing banks, where more effective desiccation and sublimation reduce soil-moisture content. Summer rainsplash and sheetwash were responsible for 11%-22% of the total erosion, amounting to 102 Mg in 1981 and 208 Mg in 1982. Although rainsplash is the most consistent process during summer, the occasional storm during which rainwash occurs causes greater total erosion. Erosion by rain increased in each of the three summers, largely because of increased precipitation. Infrequent massive deep-slip failures (slumps) have occurred at the east end of the lake where a buried clay-rich unit is stratigraphically and topographically positioned to favor such failures. Drought years followed by heavy spring rains probably will result in additional deep-slip slope failures. (Author's abstract)
W86-00898

2K. Chemical Processes

MODEL OF SULPHATE CONCENTRATION IN A SMALL STREAM IN THE HARP LAKE CATCHMENT, ONTARIO,
Oslo Univ. (Norway). Dept. of Chemistry.
For primary bibliographic entry see Field 5B.
W86-00629

FACTORS CONTROLLING MASS LOSS AND NITROGEN DYNAMICS OF PLANT LITTER DECAYING IN NORTHERN STREAMS,
Marine Biological Lab., Woods Hole, MA. Ecosystems Center.
J. M. Melillo, R. J. Naiman, J. D. Aber, and A. E. Linkins.
Bulletin of Marine Science, Vol. 35, No. 3, p 341-356, November, 1984. 13 Fig, 4 Tab, 41 Ref. NSF grants DEB-80-05081, DEB-81-05677 and DEB-82-07055.

Descriptors: *Nitrogen, *Detritus, *Decomposition, *Streams, Water temperature, Nutrients, Dissolved oxygen, Lignin, Anaerobic conditions, Aerobic conditions, Microorganisms.

In this paper the influences of initial litter quality, exogenous nutrient supply, temperature and oxygen tension on decay rates and nutrient immobilization potentials of plant litter materials decomposing in northern streams are considered. A new method of estimating nitrogen and phosphorus immobilization potentials in decaying litter is reviewed, and the mechanisms responsible for nitrogen immobilization are discussed. Initial litter quality is the dominant factor that influences decay rate. Materials rich in nitrogen and poor in lignin generally decay most rapidly. Addition of nitrogen and/or phosphorus to the water often results(s) in increased decay rate as does elevation of water temperature. While low oxygen tension retards the decay of lignin and related compounds, it is not clear that low oxygen tension slows the rate of decay of more labile compounds. Initial litter quality is also the dominant factor that influences nitrogen immobilization potential. Materials poor in both nitrogen and lignin generally have the highest immobilization potentials. Addition of nitrogen to the water increases the immobilization potential of a litter material. Plant litter decomposing under anaerobic conditions immobilizes less nitrogen than the same litter decomposing under aerobic conditions. And, all other conditions being equal, temperature changes will influence nitrogen immobilization rate but not its maximum amount. The amount of nitrogen directly associated with microbial biomass makes up only a small fraction of the total nitrogen mass in decomposing litter. Microbes appear to be important agents in the nitrogen immobilization process on decaying litter. The microbes produce exoenzymes which in turn cause the degradation of large molecules such as polyphenolics and lignins. Some of these degradation products, such as the 'reactive phenolics,' recondense with nitrogen containing compounds. The degradation-recondensation cycle continues throughout litter decay, with the ultimate product being nitrogen-rich humic substances. (Author's abstract)
W86-00637

ALTERATION OF MICROBIAL METABOLIC ACTIVITIES IN ASSOCIATION WITH DETRITUS,
North Carolina Univ. at Morehead City. Inst. of Marine Sciences.
H. W. Paerl.
Bulletin of Marine Science, Vol. 35, No. 3, p 393-408, November, 1984. 8 Fig, 1 Tab, 56 Ref.

Descriptors: *Detritus, *Microorganisms, *Metabolism, Microbial degradation, Microhabitats, Redox gradient, Protozoa, Invertebrates, Nutrients, Microzones.

Detritus serves as a microhabitat, or microzone, hosting redox gradients, altered microbial metabolism and associated biochemical nutrient transformation processes qualitatively and quantitatively distinct from the ambient planktonic environment. Through the application of tetrazolium redox indicator salts, microautoradiography and microelectrode analyses, it has shown that distributions of microbial communities and their extracellular deposition products on detrital as well as non-detrital submersed surfaces are patchy in nature, both in terms of physical distribution and associated metabolism. This patchiness promotes the development of steep redox gradients, which in turn lead to diverse microhabitats in which microorganisms, protozoans and invertebrates, all having narrow environmental tolerances, can reside. The compact nature of gradients helps promote diffusive exchange of metabolites, gases and nutrients, thereby maintaining community diversity and structural stability of microzones. Microzones also harbor specific nutrient transformation processes (i.e., nitrogen cycle N2 fixation, ammonification, nitrification and denitrification) which may otherwise be unfavorable or inhibited in ambient waters. The promotion, regulation and maintenance of specific nutrient transformation reactions in microzones are all implicated in determining nutrient availability and trophic states of affected aquatic systems. (Author's abstract)
W86-00639

CHEMICAL CHARACTERIZATION OF ESTUARINE COLLOIDAL ORGANIC MATTER: IMPLICATIONS FOR ADSORPTIVE PROCESSES,
Maryland Univ., Solomons. Chesapeake Biological Lab.
For primary bibliographic entry see Field 2L.
W86-00640

SPATIAL AND TEMPORAL COUPLING OF NUTRIENT INPUTS TO ESTUARINE PRIMARY PRODUCTION: THE ROLE OF PARTICULATE TRANSPORT AND DECOMPOSITION,
Maryland Univ., Cambridge. Horn Point Environmental Labs.
For primary bibliographic entry see Field 2L.
W86-00642

ANALYSIS OF PRECIPITATION CHEMISTRY DATA FROM ALASKA,
National Oceanic and Atmospheric Administration, Rockville, MD. Air Resources Lab.
U. Dayan, J. M. Miller, W. C. Keene, and J. N. Galloway.
Atmospheric Environment, Vol. 19, No. 4, p 651-657, 1985. 5 Fig, 3 Tab, 28 Ref.

Descriptors: *Chemistry of precipitation, *Acid rain, *Alaska, Poker Flat, Point Barrow, Path of pollutants, Acidity, Polar regions, Sulfuric acid, Air trajectories.

The chemical composition of precipitation collected at Poker Flat, Alaska and at Point Barrow, Alaska was evaluated in conjunction with backward air trajectories to characterize the long-range transport of acidic materials to central Alaska. Volume weighted mean concentrations of major chemical constituents characterized the composition and acidity of precipitation associated with air parcels which arrive at Poker Flat from three major source regions, the Pacific Ocean, local continental and the Arctic. Long-range trajectories from the south-west predominated during the spring and early summer. These air flow patterns originated in mid-latitudes and generated precipitation with moderate acidities (H(+) = 9.9 microeq/l). Weak flows, suggesting local airmasses, were important sources of precipitation during mid

summer. Local storms corresponded to higher acidities (H(+) = 12.7 micro-eq/l). During the late summer and early autumn, precipitation events were frequently associated with northerly flows and lower acidities (H(+) = 7.8 micro-eq/l). H2SO4 was the most important source of acidity contributing, on a volume weighted basis, between 46 and 80% of free H(+) in all samples. The higher concentration of SO4(2-) relative to H(+) in Arctic storms suggests long distance transport and neutralization of anthropogenic H2SO4 from the Polar region. Concentrations of excess SO4(2-) measured in precipitation from Alaska were greater than those measured in precipitation from Greenland and less than those measured in precipitation from the Yukon of Canada. (Author's abstract)
W86-00659

EFFECT OF GROUNDWATER ON SOIL FORMATION IN A MORAINAL LANDSCAPE IN SASKATCHEWAN,
Saskatchewan Univ., Saskatoon. Saskatchewan Inst. of Pedology.
For primary bibliographic entry see Field 2F.
W86-00670

DENSITY OF PRECIPITATION CHEMISTRY NETWORKS,
Kozponti Cegkorfizikai Intezet, Budapest (Hungary).
For primary bibliographic entry see Field 7A.
W86-00684

EFFECTS OF STORAGE ON THE COMPOSITION OF MAIN COMPONENTS IN RAINWATER SAMPLES,
Royal Netherlands Meteorological Inst., De Bilt.
T. B. Ridder, T. A. Buishand, H. F. R. Reijnders, M. J.'t Hart, and J. Slanina.
Atmospheric Environment, Vol. 19, No. 5, p 759-762, 1985. 3 Tab, 9 Ref.

Descriptors: *Chemistry of precipitation, *Rain, *Sample preservation, Chemical composition, Temperature, Light.

Samples from twelve rainwater collectors in The Netherlands were stored under three different conditions: (i) in the light at room temperature, (ii) in the dark at room temperature and (iii) in the dark at 4 C. In samples stored at room temperature, considerable changes occurred in ammonium and phosphate concentrations both in the light and in the dark. Minor changes were also observed for potassium, calcium, chloride, sulfate and nitrate. Storage of rainwater samples in the dark at 4 C resulted in a satisfactory sample preservation. (Author's abstract)
W86-00717

EULERIAN MODEL FOR SCAVENGING OF POLLUTANTS BY RAINDROPS,
General Motors Research Labs., Warren, MI. Environmental Science Dept.
For primary bibliographic entry see Field 5B.
W86-00718

COMPARISON OF SEVERAL METHODS FOR THE DETERMINATION OF IRON HYDROXIDES AND ASSOCIATED ORTHOPHOSPHATES IN ESTUARINE PARTICULATE MATTER,
McGill Univ., Montreal (Quebec). Inst. of Oceanography.
For primary bibliographic entry see Field 2L.
W86-00769

TRACE-METAL CONCENTRATIONS IN SEDIMENTS FROM TWO CLOSED-BASIN LAKES, ANTARCTICA,
New Hampshire Univ., Durham. Dept. of Earth Sciences.
For primary bibliographic entry see Field 2H.
W86-00770

INFLUENCE OF PH ON THE BINDING CAPACITY AND CONDITIONAL STABILITY CONSTANTS OF ALUMINUM AND NATURALLY-OCCURRING ORGANIC MATTER,
Savannah River Ecology Lab., Aiken, SC.
D. B. Pott, J. J. Alberts, and A. W. Elzerman.
Chemical Geology, Vol. 48, No. 1/4, p 293-304, March, 1985. 4 Fig, 3 Tab, 33 Ref. DOE contract EY-76-C-09-0819, NSF grant ISP-8011451.

Descriptors: *Hydrogen ion concentration, *Organic matter, *Aluminum, Humic acid, *Binding capacity, *Stability constants, Chemical reactions, Natural waters, Acidity.

The binding of Al by reagent grade humic acid and by a natural water system of the southeastern U.S.A. was investigated with special emphasis on the influence of pH. Differentiation of 'bound' Al and 'free' Al was performed using cation-exchange resins. A thermodynamic equilibrium model, GEOCHEM, was used to correct the 'bound' Al data for uncharged hydrolysis products. Two methods of data analysis, i.e. Scatchard and Langmuir regressions, were used to estimate conditional stability constants of Al-humic acid complexes. Overall stability constants (log10 K) for aluminum humate were about 6.8 with little variation over the pH range 3-5. Al binding capacities were higher in natural waters (0.99-2.86 micro-mol Al per mg DOC) relative to reagent grade humic acids (0.33-0.86 micro-mol Al per mg DOC). Both the natural waters and humic acid samples showed significant increases in Al binding capacity when pH was increased from 3 to 4 (0.99-1.84 micro-mol Al per mg DOC and 0.33-0.79 micro-mol Al per mg DOC, respectively). The humic acid showed a much smaller increase in binding capacity when the pH was increased from 4 to 5 (0.79-0.86 micro-mol Al per mg DOC). Arguments are presented to show that Al is bound to humic acid through a single type of binding site, most probably a carboxylic functionality. (Author's abstract)
W86-00773

NITROGEN TRANSFORMATIONS AND LOSS IN FLOODED SOILS AND SEDIMENTS,
Agricultural Research and Education Center, Sanford, FL.
K. R. Reddy, and W. H. Patrick.
CRC Critical Reviews in Environmental Control, Vol. 13, No. 4, p 273-309, 1984. 8 Fig, 5 Tab, 231 Ref.

Descriptors: *Nitrogen, *Flooded soils, *Sediments, Ammonification, Nitrification, Denitrification, Volatilization, Ammonia, Diffusion, Reservoirs, Wetlands.

Nitrogen transformations that account for transport of N from flooded soils and sediments to the atmosphere are reviewed. Characteristics of flooded soils and sediments, forms, sources, and trasformations of N in the environment, and the influence of plants on N loss are reviewed, and research needs in the nitrogen loss area are identified. N loss mechanisms in flooded soils are governed by N transformations (ammonification, nitrification-denitrification, and ammonia volatilization) and transport process (NH4-N diffusion and NO3-N diffusion), and the presence of plants. Nitrification-denitrification seems to be predominant in the loss of ammonium N from sediments, whereas ammonia volatilization occurs under specialized conditions, mainly in overlying waters. The processes involved in converting organic N to gaseous end products include ammonification of organic N to ammonium N, upward diffusion of ammonium N into the aerobic surface layer, oxidation of ammonium N in the aerobic soil layer, downward diffusion of nitrate N into the anaerobic soil layer, and reduction on NO3-N to gaseous end products such as N2 and N20. Data on the rates of N transformation by the various processes indicate that N diffusion and denitrification are not limiting in controlling N loss during the nitrification-denitrification sequence. Ammonium diffusion depends on the ammonium N removal mechanisms (nitrification and ammonia volatilization) in the aerobic soil layer and floodwater to establish a concentration gradient. In shallow reservoirs and wetlands flooded with wastewater, nitrification occurs at a rapid rate in the overlying water column, and the major limiting process in the removal of nitrate N from the overlying water was diffusion of NO3-N from the water column to the underlying soil column. The most important research need is for study of volatilization losses by measuring the fluxes of NH3 from an aquatic system in relation temperature, surface wind velocity, sediment characteristics, alkalinity of the water, and biological activity in the soil-water system. (Rochester-IVI)
W86-00849

2L. Estuaries

EFFECTS OF TREATED SEWAGE EFFLUENT AND BAY-BOTTOM MUD ON GROWTH OF MARINE PHYTOPLANKTON,
For primary bibliographic entry see Field 5C.
W86-00616

BIOLOGICAL CONSEQUENCES OF ICE RAFTING IN A NEW ENGLAND SALT MARSH COMMUNITY,
New Hampshire Univ., Durham. Jackson Estuarine Lab.
M. N. Hardwick-Witman.
Journal of Experimental Marine Biology and Ecology, Vol. 87, No. 3, p 283-298, May, 1985. 7 Fig, 47 Ref.

Descriptors: *Ice rafting, *Salt marshes, *Ecological effects, New England, Mussels, Peat, Algae, Cordgrass, Growth, Mortality, Predation, Simulation, Marshes.

Ice rafting of salt marsh peat is a recurrent phenomenon in north temperate regions. This process was simulated in a northern New England salt marsh to test several hypotheses concerning the effects of peat transport from high to low intertidal heights on the growth and mortality of key sessile organisms: the ribbed mussel Geukensia demissa (Dillwyn), the fucoid alga Fucus vesiculosus L. var. spiralis (Farlow) and the cordgrass Spartina alterniflora (Loisel.). Growth rates increased when Geukensia and Fucus were transported to the lower intertidal; however, Spartina died when similarly transported. Predation pressure (primarily from Carcinus maenus L.) on Geukensia was greater when it was rafted to the lower intertidal zone than in the upper intertidal habitat and was size specific; mussels > 3.5 cm reached a size-escape from crab predation. A winter survey of dislodged mussels revealed that 72% of the mussels collected were dead and 86% had been overgrown by large Fucus plants, > 2.5 x the natural frequency of Fucus overgrowth (32%). In marsh habitats where hard substratum is rare, 91% of the Fucus were growing on Geukensia. A dislodgement experiment showed that a significantly greater percentage of Geukensia was dislodged after ice-out when Fucus was attached to the shell than those mussels without Fucus overgrowth. In the spring, a population survey conducted in the salt marsh examined densities, biomass and population structure of Geukensia, as well as densities, percent cover and biomass of Fucus. Values obtained in the foremarsh were compared to those from the peat islands recently rafted to the tidal flats. Both biomass and densities of Geukensia were similar in the two areas; however, the size-frequency distributions of the mussels were different. Since fewer large mussels, Fucus and Fucus-overgrown mussels were found on the newly transported peat islands, this pattern appears to reflect dislodgement of larger Geukensia by attached algae during ice transport. Two ice-related sources of mortality were identified for Geukensia: (1) Fucus overgrowth acted as vector for mussel dislodgement and was an indirect source of mortality; and (2) ice crushing was a direct source of mortality for non-overgrown mussels. (Author's abstract)
W86-00627

RESPONSE OF A DETRITAL FOODWEB TO EUTROPHICATION,
Marine Biological Lab., Woods Hole, MA.
For primary bibliographic entry see Field 5C.
W86-00638

CHEMICAL CHARACTERIZATION OF ESTUARINE COLLOIDAL ORGANIC MATTER: IMPLICATIONS FOR ADSORPTIVE PROCESSES,
Maryland Univ., Solomons. Chesapeake Biological Lab.
J. C. Means, and R. D. Wijayaratne.
Bulletin of Marine Science, Vol. 35, No. 3, p 449-461, November, 1984. 3 Fig, 3 Tab, 49 Ref.

Descriptors: *Colloids, *Organic matter, *Adsorption, *Estuarine environment, Particulate matter, Dissolved solids, Geochemistry, Lipids, Carbohydrates, Amino acids, Seasonal variation.

Dissolved and particulate organic matter are important components of the carbon and nitrogen cycles. Because of their surface active nature and reactivity, dissolved organic colloids are also important in many geochemical processes. The chemical nature of colloidal organic matter is an important factor in determining how it will behave in relation to other substances in the system. In the present study, colloidal organic matter (> 0.4 micro-m to 1.2 nm) collected from the Chesapeake Bay estuary over a salinity range of 2 to 22% was characterized for organic carbon (DOC), lipid (TDL), carbohydrate (TDS) and amino acids (TAA). Analysis of the biochemical constituents of colloidal organic carbon indicated that (TDS), (TAA) and (TDL) account for 35-60%, 4-13% and less than 1%, respectively, of the DOC content. The TDS fraction had a predominance of glucose and galactose while the TAA fractions showed high abundances of aspartic, glutamic, serine, threonin and glycine. Seasonal changes in the TDS and TAA levels in estuarine colloids revealed that sugars and amino acids were higher in summer than in winter, and may be related to primary and secondary productivity. Enrichment of carbohydrates and amino acids in colloidal material collected near a density boundary (pycnocline) was observed. The results of this study are discussed in the light of these biogenic polymers acting as a sorbent in the enrichment. (Author's abstract)
W86-00640

DUAL-GRADIENT CONCEPT OF DETRITUS TRANSPORT AND PROCESSING IN ESTUARIES,
Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
W. E. Odum.
Bulletin of Marine Science, Vol. 35, No. 3, p 510-521, November, 1984. 7 Fig, 1 Tab, 40 Ref. NSF DEB-8109674.

Descriptors: *Detritus, *Estuarine environment, Solute transport, Particulate transport, Salinity, Marshes, Stream order, Organic carbon, Dissolved solids, Particulate matter, Productivity, Aquatic plants.

The concept that organic detritus is not uniformly distributed in estuaries, but occurs principally along two gradients, the salinity axis gradient and the marsh stream order gradient is proposed. Preliminary evidence suggests that DOC and POC are distributed along these gradients in generally decreasing concentrations from the sources, river carbon in the first case and tidal marsh carbon in the second. Processing of detritus along the salinity axis gradient is due principally to physical processes such as flocculation while biological processes play a more important role along the marsh stream order gradient. The potential carbon sources for primary consumers along the marsh stream order gradient should demonstrate a shift from predominantly vascular plant detritus, benthic microalgae, and, possibly, carbon from terrestrial sources in the low order streams to phytoplankton and phytoplankton detritus in the larger streams and embayments. Large beds of submerged macrophytes such as seagrasses can introduce considerable variation in these trends in DOC and POC concentrations. All of these phenomenon are important in considerations of the relative importance of organic detritus as an energy source for estuarine consumers. (Author's abstract)
W86-00641

SPATIAL AND TEMPORAL COUPLING OF NUTRIENT INPUTS TO ESTUARINE PRIMARY PRODUCTION: THE ROLE OF PARTICULATE TRANSPORT AND DECOMPOSITION,
Maryland Univ., Cambridge. Horn Point Environmental Labs.
W. M. Kemp, and W. R. Boynton.
Bulletin of Marine Science, Vol. 35, No. 3, p 522-535, November, 1984. 6 Fig, 1 Tab, 78 Ref.

Descriptors: *Estuarine environment, *Nutrients, *Primary productivity, *Particulate transport, *Decomposition, *Patuxent River, *Maryland, Solute transport, Nitrogen, Phosphorus, Dissolved solids, Particulate matter, Plankton, Salinity, Sedimentation, Resuspension, Water temperature.

Spatial and temporal aspects of the coupling of nutrient inputs to estuarine primary production are discussed in terms of formation, transport and decomposition of particulate material in the Patuxent River estuary. Mixing diagrams of dissolved and particulate nitrogen and phosphorus (DIN, PN, DIP, PP) versus salinity indicate rapid removal of DIN and DIP with parallel formation of PN and PP in the slightly brackish (0-5%) region. However, plankton production (per sq m) tends to be inversely related to salinity between 0 and 10%. While most of the annual nutrient inputs to the Patuxent occur between December and April, peak plankton production occurs in the summer. Deposition and resuspension of particulate substances in this system are dynamic processes which decrease in a seaward direction. Regeneration of DIN and DIP from particlate decomposition in the sediments similarly decreases toward the estuary's mouth; however, highest rates are in the 5-10% region. Temporal patterns of benthic regeneration and plankton production are congruent (being generally related to temperature), and rates of sediment NH4(+) recycling represent about 60-80% of the plankton assimilative demand in the 5-10% region. On the basis of these observations a conceptual model is proposed in which annual inputs of dissolved nutrients from runoff are converted into particulate forms which are gradually transported seaward through cycles of deposition and resuspension. As temperatures rise in the summer these particulates are decomposed, releasing dissolved nutrients to the euphotic zone where they support the major annual blooms of plankton. By comparing these patterns for the Patuxent with those reported for other estuaries, it is suggested that this model may be relatively general for many coastal systems. (Author's abstract)
W86-00642

GROWTH IN BIOMASS OF BALANUS BALANOIDES YOUNG AT VARIOUS CURRENT VELOCITIES,
Akademiya Nauk SSSR, Moscow. Inst. of Evolutionary Morphology and Animal Ecology.
For primary bibliographic entry see Field 2H.
W86-00721

EFFECT OF VELOCITY OF WATER FLOW ON GROWTH OF COLONIAL HYDROIDS (HYDROZOA, THECAPHORA),
Moscow State Univ. (USSR).
For primary bibliographic entry see Field 2H.
W86-00722

COMPARISON OF SEVERAL METHODS FOR THE DETERMINATION OF IRON HYDROXIDES AND ASSOCIATED ORTHOPHOSPHATES IN ESTUARINE PARTICULATE MATTER,
McGill Univ., Montreal (Quebec). Inst. of Oceanography.
M. Lucotte, and B. d'Anglejan.
Chemical Geology, Vol. 48, No. 1/4, p 257-264, March, 1985. 2 Fig, 3 Tab, 24 Ref.

Descriptors: *Iron hydroxides, *Orthophosphates, *Particulate matter, *Estuarine environment, Minerals, Sediments, Suspended solids, Analytical methods, Phosphorus, St. Lawrence Seaway, Eastmain River Estuary, Quebec.

Five different methods commonly used for the extraction and the determination of iron hydroxides and/or the associated phosphorus held in marine seston or in sediments have been tested on single-phase minerals (goethite and apatite), on reference minerals (SO1 and SO2), and on suspended-matter samples from the St. Lawrence Estuary and from the estuary of the Eastmain River, a major James Bay affluent in northern Quebec, Canada. The citrate-dithionite-bicarbonate (CDB) procedure generally seemed to be more reproducible and more specific. The validity of the other methods respectively using as extracting reagents ammonium oxalate-oxalic acid, hydroxylamine hydrochloride, calcium nitrilotriacetic acid and acetate-tartrate is discussed. The CDB extraction is included in an analytical scheme which allows to distinguish between three fractions of phosphorus. This chemical speciation is applied to the study of P retention on Fe-hydroxides, and to its potential desorption. (Author's abstract)
W86-00769

HISTORICAL CHANGES IN SUBMERGED MACROPHYTE COMMUNITIES OF UPPER CHESAPEAKE BAY,
California Univ., Santa Barbara. Dept. of Geography.
For primary bibliographic entry see Field 2H.
W86-00828

SEASONAL CYCLES OF PHYTOPLANKTON POPULATIONS AND TOTAL CHLOROPHYLL OF THE LOWER ST. JOHNS RIVER ESTUARY, FLORIDA,
University of North Florida, Jacksonville. Dept. of Natural Sciences.
C. DeMort, and R. D. Bowman.
Biological Sciences, Vol. 48, No. 2, p 96-107, 1985. 5 Fig, 4 Tab, 18 Ref.

Descriptors: *Phytoplankton, *Chlorophyll, *Seasonal variation, *St. Johns River Estuary, *Florida, Population dynamics, Species diversity, Salinity, Phosphates, Hydrogen ion concentration, Estuarine environment.

Monthly plankton collections and water analyses were made at 7 stations along the lower 42 km of the St. Johns River Estuary (Florida) for a 2-yr period. Measurements included temperature, light extinction, salinity, dissolved oxygen, chlorophyll, nutrients, iron, copper, turbidity and pH. All of the stations exhibited major peaks in cell numbers and chlorophyll in June or July and secondary peaks in December or January. The total number of distinct population peaks decreased from 4, near the river's mouth, to 2 at the upper stations. Species diversity decreased with distance from the river's mouth, whereas, chlorophyll concentration increased. The chlorophyll concentration was correlated closely with cell counts at most stations. Population density appeared to be most closely correlated with salinity, phosphate, and pH. High N:P ratios occurred throughout the year, suggesting that phosphorus is more limiting than nitrogen in the St. Johns River system. (Author's abstract)
W86-00900

INFLUENCE OF SALINITY ON SCIRPUS AMERICANUS TIDAL MARSHES IN THE ST. LAWRENCE RIVER ESTUARY, QUEBEC,
Laval Univ., Quebec. Dept. of Civil Engineering.
J. Deschenes, and J.-B. Serodes.
Canadian Journal of Botany, Vol. 63, No. 5, p 920-927, May, 1985. 4 Fig, 1 Tab, 22 Ref.

Descriptors: *Salinity, *Tidal marshes, *Bulrushes, *St. Lawrence River estuary, *Quebec, Sodium, Aquatic plants, Marshes, Brackish waters, Estuaries.

The amount of sodium in the aboveground part of the stalks of Scirpus americanus taken at the peak of biomass is a good indicator of the amount of salinity in the waters flooding the tidal marshes of an estuary. In fresh water, the Na concentrations remain below 10,000 and then increase sharply up to 20,000 - 30,000 mg/kg in brackish waters. Even

though this plant can grow under brackish conditions, salinity has a considerable effect on the percentage of submersion it can withstand. Consequently, in the presence of saline water, the lower limit of the vegetation regresses towards the shore. In the case of fresh water, Scirpus americanus occupies the lower part of marshes up to an average of 75% of submersion, while in brackish water it extends to about 35% and then disappears when waters are more saline. (Author's abstract)
W86-00902

3. WATER SUPPLY AUGMENTATION AND CONSERVATION

3B. Water Yield Improvement

LENGTH AND SLOPE EFFECTS ON RUNOFF FROM SODIUM DISPERSED, COMPACTED EARTH MICROCATCHMENTS,
Arizona Univ., Tucson. Dept. of Soils, Water and Engineering.
S. R. Evett, and G. R. Dutt.
Soil Science Society Journal of Americal, Vol. 49, No. 3, p 734-738, May-June, 1985. 3 Fig, 3 Tab, 22 Ref. USDA grant 82-CRSR-2-2005.

Descriptors: *Water harvesting, *Runoff, *Microcatchments, *Compacted earth, *Slope, *Downslope length, Salts, Rainfall intensity, Model studies, Salinity, Storms, Soil permeability.

A study was conducted on the effects of slope and downslope length on daily runoff and erosion from earthen microcatchments treated with sodium salt and compacted. Two replicates of a two-factor experiment, including 1, 5, 10, and 15% slopes and 3- and 6-m lengths, were built on a gravelly sandy clay loam (mixed mineralogy) using 11.2 t/ha of NaCl mixed into the surface 2 to 5 cm of soil followed by compaction with a 6-t roller after a heavy rain. Total runoff was measured volumetrically after each of 18 storms. Both slope and length had effects on runoff significant at the 0.1% probability level but the effect of rainfall intensity was not significant. The best fit linear model of runoff explained about 98% of the variability in runoff on individual plots for individual storms but explained no differences in runoff among treatments. A nonlinear model incorporating slope and length accounted for about 96% of the variability in average total runoff among treatments. This model shows that the important differences in runoff among treatments can be explained by slope and length alone for these conditions. Only a minor salinity problem but slight to moderate permeability problems might be expected. No apparent problems have arisen in 12 yr of grape and fruit tree cultivation in a water harvesting system using this type of catchment on the same soil. (Moore-IVI)
W86-00705

WATER FOR SALT LAKE CITY,
Salt Lake City Dept. of Public Utilities, UT.
W. E. Evensen.
Public Works, Vol. 116, No. 6, p 102-104, June, 1985. 2 Fig.

Descriptors: *Salt Lake City, *Utah, *Water supply development, *Water conveyance, Water mains, Tunnel construction, Reservoir construction, Financing.

Salt Lake City, Utah, is the major trading center of the Intermountain region of the western United States. In recent years it has experienced a population decline concomitant with an increase in demand for water from the city supply system. This demand resulted from expansion of non-residential developments, including office buildings and hotels. Today's demand of about 96,000 acre-ft is met through four treatment plants located on canyon streams leading from the Wasatch Mountains. Beginning in 1984, additional water became available from the Jordan Aqueduct portion of the Central Utah Project. To take advantage of this supply a large connecting supply line was needed to bring the water to the city's west side. Since 1976, a capital improvement program has been underway to provide the connection to the aqueduct and a 12 million gallon terminal, the Victory Road Reservoir. Numerous engineering challenges were presented by different phases of this project, including dealing with seepage from beneath the reservoir site, tunneling beneath a major railway line, and evaluation of the hazard connected with major water mains crossing a fault line. The city's former cash-only financing methods had to be changed to obtain $25 million for funding the project. In addition to the reservoir, which is 280 ft in diameter, 30 ft deep, and completely buried, major 48 inch and 36-inch supply lines, major 30- and 24-inch branches, and tie-ins to existing distribution systems were constructed. (Rochester-IVI)
W86-00809

BULK SUPPLY SCHEME OF THE MID SOUTHERN AND NORTH SURREY WATER COMPANIES,
North Surrey Water Co., Staines (England).
P. O. Packham, and E. G. Moss.
Journal Institution of Water Engineers and Scientists, Vol. 39, No. 2, p 155-168, April, 1985. 5 Fig, 1 Append.

Descriptors: *Water supply development, *England, *Thames River, Organizations, Pipelines, Water transport, Costs, Economic aspects, Administrative agencies.

The Mid Southern Water Company (England), which serves an area undergoing rapid population increase due to 'overspill' from the city of London, successfully increased its capacity by cooperating with the North Surrey water company in a bulk supply scheme. Water is obtained from the upper Thames at the North Surrey's Egham plant, and pumped to a new reservoir constructed at Surrey Hill, from which water is distributed into the existing Mid Southern network. To carry water from Egham to Surrey Hill, a 900 mm trunk main 20.5 km long was constructed. Project costs were (million pounds sterling): Egham works, new pumphouse and uprating of treatment plant, 1.3; trunk main, 4.6; and Surrey Hill Reservoir (excluding outlet main), 1.3. A bulk supply of up to 22 million liters/day can be obtained from the new system, which has been averaging 18 million liters/day since opening in June of 1982. Additional development of Egham Works in the future will bring the bulk supply up to 75 million liter/day. This project was administratively complex because it involved two separate water companies, plus water under the control of the Thames Water Authority. The history of administrative and legal arrangements and discussions of cost sharing are detailed in this paper. (Rochester-IVI)
W86-00835

3F. Conservation In Agriculture

CHEMICAL AND STUBBLE-MULCH FALLOW INFLUENCES ON SEASONAL SOIL WATER CONTENTS,
Agricultural Research Service, Sidney, MT. Northern Plains Soil and Water Research Center.
D. L. Tanaka.
Soil Science Society of America Journal, Vol. 49, No. 3, p 728-733, May-June, 1985. 5 Fig, 1 Tab, 25 Ref.

Descriptors: *Conservation tillage, *Soil water content, *Fallow, Seasonal variation, Chemical fallow, Stubble mulch fallow, Water conservation, Precipitation frequency.

A study was conducted in the northern Great Plains to determine the effect of chemical and stubble-mulch fallow of a Williams loam (fine-loamy mixed, Typic Argiborolls) on soil water contents during 14- and 21-month fallow periods. Soil water contents to a depth of 1.70 m measured by use of the neutron-scatter technique for two 14- and three 21-month fallow periods. The amount of surface residue after harvest range from 0.6 to 3.6 Mg/ha during the study. Chemical fallow maintained more surface residue than stubble-mulch fallow, but no significant differences in soil water contents to 1.70-m soil depth occurred between the treatments. Gain in soil water occurred after harvest and over the first winter with soil water loss generally occurring during summer for 14- and 21-months of fallow. No gain in soil water contents occurred over the second winter when chemically fallowed for 21-months. Precipitation frequency and distribution may be just as important as quantity and position of surface residue for chemicals fallow to effectively store more soil water than stubble-mulch fallow. (Author's abstract)
W86-00704

SEEPAGE-LIMITATION OPTIMIZATION OF THE SHAPE OF AN IRRIGATION CHANNEL BY THE INVERSE BOUNDARY-VALUE PROBLEM METHOD,
N. B. Il'inskii, and A. R. Kasimov.
Fluid Dynamics, Vol. 19, No. 3, p 404-410, May-June, 1984. 6 Fig, 13 Ref.

Descriptors: *Irrigation practice, *Channel morphology, *Seepage, *Inverse boundary-value method, Soil water, Backwater, Capillarity, Evaporation, Infiltration, Drainage.

Equations are presented for finding the optimal cross-sectional shape for an irrigation channel to minimize seepage loss. Seepage was assumed to be one-dimensional, steady, and to satisfy Darcy's law. Capillarity, infiltration, and evaporation were ignored in the calculations, which account for seepage without backwater, seepage with backwater (ie, when the velocity at infinity vanishes), seepage into a horizontal drainage layer, and seepage into a water-bearing layer. For channels with unit cross-sectional area, the seepage without backwater from the optimal channel is 5.67% smaller than for a rectangular channel, and the reduction compared to a trapezoidal channel is 6.2%. In the case of an optimal channel through a permeable layer, the head in the underlying horizontal permeable layer has a profound effect on seepage flow rate of the optimal channel. (Rochester-IVI)
W86-00869

4. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control Of Water On The Surface

MONITORING URBAN WATERWAYS TO REDUCE FLOOD DAMAGE AND ENSURE PUBLIC SAFETY,
Canadian Applied Technology, Toronto (Ontario).
E. House.
Water and Pollution Control, Vol. 123, No. 3, p 22-23 and 59, May/June, 1985.

Descriptors: *Flood control, *Forecasting, *Toronto, *Ontario, Monitoring, Rivers, Flow, Telemetry, Measuring equipment, Remote sensing.

The primary objective of the Metropolitan Toronto and Region Conservation Authority's (MTRCA's) flood forecasting center is to provide the public, business and local municipalities with sufficient advanced warning of possible flooding events, along with the magnitude and the duration of the hazard. In order to provide the most accurate and timely forecasts, the urban hydrologist must act quickly to collect the most historical and current information for each river system. This information is used in conjunction with hydrologic knowledge of each river system, such as the ever changing information on watershed land use, its physiography, stream flow and the state of flood control facilities. The MTRCA monitors the river systems' water level or flow, snow pack information, soil conditions and weather information such as the duration and amount of precipitation, temperature, relative humidity, wind speed and direction. The MTRCA has identified 33 major flood prone sites and 200 minor flood prone sites on its river systems. Located at stragetic sites, usually

upstream from a flood prone site, are small shelters called gauging houses which measure the river's water level in order to determine flow. The use of logging as well as telemetering equipment enables constant contact to be maintained with the measuring stations. (Baker-IV)
W86-00687

CHANGES IN SOIL CARBON AND NITROGEN DUE TO IRRIGATION DEVELOPMENT IN NEBRASKA'S SANDHILL SOILS,
Nebraska Univ.-Lincoln. Dept. of Agronomy.
For primary bibliographic entry see Field 6G.
W86-00703

DEVELOPING AN EFFECTIVE STORM DRAINAGE MAINTENANCE PROGRAM,
Fort Collins, CO.
M. Engemoen, M. Mercer, and R. E. Krempel.
Public Works, Vol. 116, No. 6, p 84-88, June, 1985.

Descriptors: *Maintenance, *Drainage systems, *Storm drains, *Fort Collins, *Colorado, Management planning, Land use planning, Channels.

Maintenance of storm drainage ways has lagged behind other public works management practices. Recent experiences in Fort Collins, Colorado, demonstrate both how neglected channels can become a problem and how an organized maintenance effort can achieve a solution. Maintenance of storm drainage facilities first involves planning, in which problems, needs, and opportunities are evaluated and goals and objectives are specified. Second, the plan must be implemented through establishment of policies, programs, and priorities. Physical upkeep is not the only function required. Organizational and financial arrangements must be designed to achieve the objectives. Three examples that go beyond physical upkeep and incorporate maintenance aspects into the overall stormwater programs are (1) design criteria, which formalize preventive maintenance through good design, (2) basin master planning, and (3) open space/land use considerations. The final stage in maintenance is implementation, evaluation, and verification of effectiveness of the program, in which three key issues are (1) communicating with the public, (2) maintaining quality of maintenance efforts, and (3) being creative in both physical and management aspects of drainage maintenance. (Rochester-IVI)
W86-00806

PROPORTIONAL WEIRS FOR STORMWATER POND OUTLETS,
EGC-Southwell, Inc., Englewood, CO.
For primary bibliographic entry see Field 8A.
W86-00887

4B. Groundwater Management

HYDROLOGIC AND VEGETATIONAL CHANGES RESULTING FROM UNDERGROUND PUMPING AT THE CYPRESS CREEK WELL FIELD, PASCO COUNTY, FLORIDA,
Southwest Florida Water Management District, Brooksville.
For primary bibliographic entry see Field 6G.
W86-00899

4C. Effects On Water Of Man's Non-Water Activities

MODELING THE CUMULATIVE EFFECTS OF FOREST PRACTICES ON DOWNSTREAM AQUATIC ECOSYSTEMS,
Kock and Associates, Wenatchee, WA.
For primary bibliographic entry see Field 6G.
W86-00651

DESTRUCTION OF WATER RESOURCES - THE MOST CRITICAL ECOLOGICAL CRISIS OF EAST ASIA,
International Union for Conservation of Nature and Natural Resources, New Delhi (India).
N. D. Jayal.
Ambio, Vol. 14, No. 2, p 95-98, 1985. 3 Fig, 4 Ref.

Descriptors: *Water resources development, *East Asia, *Water pollution effects, *Hydrological cycle, Environmental effects, Planning, Water management, Drought, Water conservation.

The destruction of the life-support systems of the poor and marginal populations in the East Asian region is the real cause of growing poverty and deprivation that in turn is related to a whole spectrum of economic and social problems. The destruction of water resources is increasingly becoming the most severe threat to survival in the countries of the south. This destruction is arising in two ways: by the disruption of the hydrological cycle on which the renewability and sustained availability of water depends, and by the pollution of water systems with industrial and urban wastes. Conventional meanings of water conservation reflect the engineering approach to handling of the natural-resource crises. Water conservation in this approach is reduced to impounding river water in large dams, to building large networks of concrete-lined canals. This water conservation strategy does not solve the water crisis of the marginal populations. A water conservation strategy that aims at being sustainable needs to be based on ecological principles. It has to recognize that water resources get destroyed either by excessive withdrawals of natural resources from an ecosystem or by excessive additions of wastes into an ecosystem. Conservation of water in Asian societies means avoiding the destructive and distorted use of resources. It means respecting essential ecological processes like the hydrological cycle and the difference between vital and non-vital needs. (Baker-IVI)
W86-00666

GOLD-MINING EFFECTS ON STREAM HYDROLOGY AND WATER QUALITY, CIRCLE QUADRANGLE, ALASKA,
Alaska Univ., Fairbanks. Inst. of Water Resources.
D. M. Bjerklie, and J. D. LaPerriere.
Water Resources Bulletin, Vol. 21, No. 2, p 235-243, April, 1985. 3 Fig, 4 Tab, 8 Ref. EPA project 808340-01.

Descriptors: *Gold mining, *Hydrology, *Water pollution effects, *Circle Quadrangle, *Alaska, Placer mining, Streams, Subsurface water, Chemical properties, Water level, Stream flow, Specific conductance, Dissolved oxygen, Mine drainage, Sediments.

Effects of placer mining on the hydrology and water quality of several interior Alaska streams were studied as part of a project on the impacts of placer mining on stream ecosystems. Surface and subsurface waters were analyzed in the field for conductivity, pH, temperature, alkalinity, total and calcium hardness, iron, copper, manganese, ammonia-N, nitrate-N, nitrite-N, settleable solids, and turbidity. Total, nonfiltrable, and filtrable residues were determined in the laboratory. In the streams placer mining increased turbidity, settleable solids, nonfiltrable and filtrable residues and total iron. Surface and subsurface water levels, as measured in wells driven in the stream beds, were correlated with stream flow. Fine sediment deposited on stream beds in mined drainages reduced the hydraulic contact between the surface and subsurface waters of the stream and caused the piezometric water level to be below the surface water level of the mined streams. This resulted in higher specific conductance and significantly lower dissolved oxygen concentrations in the subsurface waters of mined streams compared to their surface waters. No significant differences were found for any water quality characteristics comparing surface to subsurface waters for the unmined streams. (Author's abstract)
W86-00785

4D. Watershed Protection

USING SIMULATION TO ASSESS THE IMPACTS OF CONSERVATION TILLAGE ON MOVEMENT OF SEDIMENT AND PHOSPHORUS INTO LAKE ERIE,
Purdue Univ., Lafayette, IN. Dept. of Agricultural Engineering.
D. B. Beasley, E. J. Monke, E. R. Miller, and L. F. Huggins.
Journal of Soil and Water Conservation, Vol. 40, No. 2, p 233-237, March/April, 1985. 1 Fig, 6 Tab, 11 Ref.

Descriptors: *Erosion control, *Lake Erie, *Conservation tillage, *Sediment transport, *Phosphorus, Simulation, Nutrients, Sediment yield, Agricultural watersheds, Tillage.

Attempts were made to develop and test a methodology based on the ANSWERS model for making basin wide predictions of sediment and nutrient yields using a small, stratified sample; to provide a means of quantifying the impacts that various conservation tillage applications could have on overall sediment and P yields to Lake Erie; and to study the effects of different sample sizes on the predicted basin responses. Eighteen sample watersheds, a 1.0% sample of the total Lake Erie basin, represented the major soil groups in the area of study. Land in the study area was typically flat to rolling, requiring both subsurface and surface drainage. The cropland, between 65 and 80% of the area, is productive. Typical tillage management included fall moldboard plowing and spring disking. But use of the chisel plow and several conservation tillage practices is increasing. Soil erosion rates and associated P yields in the western basin are rather small compared with those in many highly productive agricultural areas. The basic problems are that the soils typically have a high clay content and thus a large capacity for P transport. The receiving body, Lake Erie, is already eutrophic. The simulation concluded that the reduction achievable in phosphorus and sediment transport from conservation tillage only probably would not meet the international agreement goals. The roughly 1,100 t/yr reduction required of the study area could only be met with a greater than 50% change over to no-till. A realistic, short-term expectation might be a 50% switch to chisel plowing resulting in a reduction of 831 t/yr if the entire basin is treated or of 587 t/yr if only group 2 soils were treated. (Baker-IVI)
W86-00650

WATERSHED PLANNING FOR ACID MINE DRAINAGE ABATEMENT,
Georgia Univ., Athens. School of Environmental Design.
B. K. Ferguson.
Water Resources Bulletin, Vol. 21, No. 2, p 253-263, April, 1985. 13 Fig, 1 Tab, 10 Ref.

Descriptors: *Acid mine drainage, *Watershed management, *Water pollution control, *Blacklick Creek Watershed, *Pennsylvania, Planning, Priorities, Abandoned mines, Water quality, Land use, Mapping.

Acid drainage from abandoned mines is a widespread problem in old mining regions. Agencies seeking to abate it face the prospect of dealing with hundreds of potential abatement projects, stretching decades into the future. A systematic regional analysis is necessary to establish locations, objectives, priorities, and phasing of such projects. The U.S. Bureau of Mines developed a novel procedure for abatement planning in the 420 square mile Blacklick Creek Watershed in Pennsylvania. The plan sought to direct abatement projects toward pollution sources where degradation was worst and adverse effects greatest. It established abatement priorities by comparing the 'supply' of sources to be reclaimed (the degrees of old mines' water quality degradation) with the 'demand' for abatement to be done (the natural and cultural values represented by the region's demography, land use and other non-mining characteristics). Matrices were used to define the relationships among mining and non-mining factors; maps were developed to show the geographic distribution of the conclusions. The locations, priorities, and phasing of abatement objectives shown on the maps should provide guidance for any abatement effort,

no matter what type of technology is applied to achieve the objectives. Over the many years in which abatement projects are to be performed in the Watershed, the plan can be used to define, coordinate, and establish priorities for the projects in a manner that can result in maximum abatement benefits from the application of limited funds. (Author's abstract)
W86-00787

ECONOMICS OF EROSION CONTROL IN A SUBTROPICAL WASTERSHED: A DOMINICAN CASE,
Ohio State Univ., Columbus. Dept. of Agricultural Economics and Rural Sociology.
For primary bibliographic entry see Field 2J.
W86-00894

5. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification Of Pollutants

EFFECT OF SULFITE DECHLORINATION ON THE ACCUMULATION OF WATERBORNE LEAD BY RAINBOW TROUT (SALMO GAIRDNERI),
Canada Centre for Inland Waters, Burlington (Ontario).
P. V. Hodson, and D. J. Spry.
Canadian Journal of Fisheries and Aquatic Sciences, Vol. 42, No. 4, p 841-844, April, 1985. 1 Fig, 1 Tab, 15 Ref.

Descriptors: *Bioassay, *Lead, *Sulfites, *Dechlorination, *Trout, Bioaccumulation, Heavy metals, Organic matter, Water treatment, Charcoal filtration.

Chlorine can be removed from laboratory water supplies by reduction with sodium sulfite, but sulfite complexation of metals may bias aquatic toxicity tests. The effect of waterborne sulfite on the accumulation of waterborne lead by rainbow trout (Salmo gairdneri) was tested. After 96 h, the blood lead levels of trout exposed to both 100 micro-g lead/L and 440 micro-g sodium sulfite/L were lower than those exposed to lead alone. The highest level of sodium sulfite having no effect on blood lead was 20 micro-g/L. The addition of 200-300 micro-g sodium sulfite/L to the water supply after charcoal filtration removed residual chlorine levels rapidly and completely. This reaction, and other possible reactions with organic matter, always reduced measureable sulfite levels to less than 1 micro-g/L (limit of detection), a level much lower than those tested. Hence, sulfite dechlorination should not interfere with metal bioassays. (Author's abstract)
W86-00615

OLIGOCHAETE COMMUNITIES OF THE SUBLITTORAL AS INDICATORS OF LAKE GENEVA EUTROPHICATION,
Conservation de la Faune, Saint-Sulpice (Switzerland).
C. Lang.
Archiv fur Hydrobiologie, Vol. 103, No. 3, p 325-340, May, 1985. 3 Fig, 4 Tab, 28 Ref.

Descriptors: *Oligotrophic lakes, *Eutrophication, *Lake Geneva, *Switzerland, *Oligochaetes, Population dynamics, Water pollution effects, Sublittoral zone, Pollution indicators, Bioindicators, Monitoring.

The oligochaete communities, mostly tubificid and lumbriculid worms, were sampled in 1982 in the sublittoral area (40 m deep) on the northern coast of Lake Geneva (Switzerland) and results were compared to those from a 1977 study. Primary production of phytoplankton in the lake and organic inputs by the Rhone River (70% of total input) were lower before the 1977 survey than before the 1982 survey. The absolute density of all the oligochaetes, of mesotrophic and of eutrophic worm species was higher in 1982 than in 1977, even if differences due to the more efficient sampling were eliminated. In both surveys, the absolute density of oligotrophic species was the same. These species were less abundant than mesotrophic or eutrophic species. The relative density of mesotrophic worm species was higher in 1982 than in 1977, perhaps due to the effect of the season. The percentage of oligochaete communities typical of mesotrophic conditions, i.e. wherein relative density of mesotrophic species was equal or superior to 50%, was higher in 1982 than in 1977. In 1982, the mean biomass of the macrobenthos per area decreased according to the increase in distance from the inflow of the Rhone River. The proportion of the oligochaete communities typical of oligotrophic, of mesotrophic and of eutrophic conditions encountered during the 1977 and the 1982 surveys was used to indicate the probability for Lake Geneva to be in a given trophic state. (Baker-IVI)
W86-00624

FLUORIMETRIC DETERMINATION OF TRACE HYDROGEN PEROXIDE IN WATER WITH A FLOW INJECTION SYSTEM,
Texas Tech Univ., Lubbock. Dept. of Chemistry.
H. Hwang, and P. K. Dasgupta.
Analytica Chimica Acta, Vol. 170, No. 2, p 347-352. 3 Fig, 17 Ref. U.S. EPA grant R810894-010.

Descriptors: *Fluorometry, *Hydrogen peroxide, *Flow injection, Hydroxyphenylacetic acid, Peroxidase, Ammonia, Water analysis, Chemical analysis, Chemistry of precipitation.

Although many selective spectrophotometric and electrochemical methods for determination of hydrogen peroxide have been described, the requisite sensitivity for applications to precipitation and cloudwater limits the approaches to the more sensitive luminescence methods. A fluorimetric flow-injection procedure with a single reagent solution containing p-hydroxyphenylacetic acid, peroxidase and ammonia permits the determination of aqueous hydrogen peroxide in the range 10 to the -8 power to 10 to the -4 power M; 30-60 samples can be processed per hour. The method exhibits a wide linear range and is insensitive to sample pH within the range 2-6. After 48 h the determination of very low concentrations was impaired. (Collier-IVI)
W86-00645

METHOD FOR AQUATIC MULTIPLE SPECIES TOXICANT TESTING: ACUTE TOXICITY OF 10 CHEMICALS TO 5 VERTEBRATES AND 2 INVERTEBRATES,
Environmental Research Lab.-Duluth, MN.
G. L. Phipps, and G. W. Holcombe.
Environmental Pollution (Series A), Vol. 38, No. 2, p 141-157, 1985. 4 Tab, 19 Ref.

Descriptors: *Toxicity, *Testing procedures, *Fish, *Invertebrates, Organic compounds, Water pollution effects, Crayfish, Snails, Chlorinated hydrocarbons.

A more efficient method was sought for conducting aquatic acute toxicity tests so the resulting data would be directly comparable between species. This method produced LC50 data on several species at a fraction of the time and money it takes to produce them by using individual tests for each species. Species tested included fathead minnows, goldfish, channel catfish, bluegill, rainbow trout, crayfish, snails, and chinook salmon. Compounds tested included pentachlorophenol, 2-chloroethanyl, 2,4-pentanedione, hexachloroethane, alpha-bromo-2',5'-dimethoxyacetophenone, benzaldehyde, 1,3-dichloro-4,6-dinitrobenzene, dursban, sevin, and cadmium chloride. The method as developed permits acute toxicity tests to be conducted on several species in different chambers of the same exposure tank. It allows an easy determination of the most sensitive species and cuts cost of labor, materials and chemical analyses for measured concentration tests. (Baker-IVI)
W86-00654

ALLIUM TEST ON RIVER WATER FROM BRAAN AND SAXAN BEFORE AND AFTER CLOSURE OF A CHEMICAL FACTORY,
Lund Univ. (Sweden). Inst. of Genetics.
G. Fiskesjo.
Ambio, Vol. 14, No. 2, p 99-103, 1985. 5 Fig, 2 Tab, 23 Ref.

Descriptors: *Allium test, *Water analysis, *Industrial wastes, *Braan, *Saxan, *Sweden, Water pollution effects, Water quality control, Monitoring, Herbicides, Phenoxyacetic acids, Phenols, Organic compounds, Cytogenetics.

The Allium test has been shown to be helpful and efficient in revealing and evaluating the biological risks attributable to the water of the river Braan (Sweden) and the nearby Saxan after the contamination of the Braan with industrial waste products. The recovery of the river water after the removal of the source of contamination could also be observed with the Allium test. The test is simple and inexpensive and can easily be applied on the mere suspicion of contamination. In its simplest form, involving only measurements of the root bundles after 3-4 days of growth, the test is ideal for rapid scanning of water samples in the field. It may be applied extensively as a preliminary to more sophisticated methods. Good correlation has been demonstrated between reduced root growth and presence of microscopic signs of cell poisoning. Detailed cytogenetic analysis can elucidate the specific types of microscopic aberrations induced. In the present case, in which phenoxyacetic acids and phenols were the culprits, the main cytogenetic aberrations included delayed mitoses and sticky chromosomes, which are known to be characteristic features of this type of poisoning. The experienced cytogeneticist may often gather valuable information about the nature of contaminants from a detailed analysis of cellular responses. (Baker-IVI)
W86-00667

AUTOMATIC WATER QUALITY MONITORING IN RIVERS EXPOSED TO INJURIOUS ACTIVITIES,
National Board of Waters, Helsinki (Finland).
T. Kohonen.
Aqua Fennica, Vol. 14, No. 2, p 97-127, 1984. 13 Fig, 12 Tab, 30 Ref.

Descriptors: *Water quality, *Monitoring, *Rivers, *Finland, Water pollution effects, Construction, Pulp and paper industry, Wastewater pollution, Industrial wastes, Water analysis, Automation.

Automatic mobile water quality monitoring stations were used to investigate the effects of the pulp and paper industry, municipal waste water, water regulation and construction work on the quality of river water. The variations found were also examined to determine the need to change the sampling frequency of manual monitoring. The frequent automatic monitoring revealed short-term variations and gave more reliable means and ranges than monitoring based on infrequent manual sampling. Where extensive data was available from manual monitoring for the same year or a period of several years, the statistical parameter calculated from the manually and automatically collected data were almost the same. In river waters with heavy loading the choice of monitoring method is dependent on the intended use of the data. It is possible to obtain adequate data on the average quality of the water by ordinary sampling at random intervals. By means of automatic monitoring it is possible to examine the effects of various load conditions on the quality of the river water at the times which are of greatest significance. (Baker-IVI)
W86-00671

STATISTICAL MODEL FOR CONVERSION OF ABSORBANCE MEASUREMENTS WITH SIGNIFICANT IRON INTERFERENCE INTO ORGANIC CARBON IN A POLYHUMIC LAKE,
Helsinki Univ. (Finland). Dept. of Limnology.
V. Pennanen, and T. Frisk.
Aqua Fennica, Vol. 14, No. 2, p 171-178, 1984. 6 Fig, 2 Tab, 22 Ref.

Descriptors: *Statistical models, *Iron, *Polyhumic lakes, *Humic substances, *Color, Absorbance, Manganese, Aluminium, Water quality, Nitrates, Organic carbon.

Statistical models are presented for taking into account the interference of iron in the conversion of absorbance values into organic carbon in studies of the color of humic waters. The models were calculated for two humic fractions (colloidal and dissolved) which were separated by gell fractionation techniques. An assumption was made that the effect of iron on absorbance was strictly proportional to the iron content of the fraction. There are other interfering substances in absorbance measurements of humic substances. Among these are manganese, aluminium, and nitrate which cause interferences in the optical measurements in the ultra-violet and in the visible regions of the spectra. Coefficients computed on the basis of the data supplied here cannot be applied to other data sets as their general validity has not been tested. (Baker-IVI)
W86-00676

STATISTICAL DETERMINATION OF THE OPTIMAL SAMPLE SIZE OF SECONDARY EFFLUENT BOD5 AND SS,
Environmental Protection Service, Edmonton (Alberta).
E. C. Tsai.
Environmental Monitoring and Assessment, Vol. 5, No. 2, p 177-183, June, 1985. 2 Fig, 2 Tab, 7 Ref.

Descriptors: *Model studies, *Biochemical oxygen demand, *Suspended sediments, Statistical models, Mathematical studies, Water quality control, Monitoring.

On the basis of the assumption of random and independent observations from a long-normal population, a statistical model for determining the optimal sample size of secondary effluent BOD5 and SS has been presented. This model is also applicable to a non-lognormally distributed effluent variable if its sample size is large. The model can be used by a plant operator or a regulatory agency to formulate an effluent monitoring plan for an individual municipal or industrial wastewater treatment facility, based on actual historical operation data. To achieve an annual sample geometric mean error within 10% at a 95% confidence level, the optimal sample sizes for activated sludge effluent BOD5 have been found to range, depending on the coefficient of variation, from 40-200 in a year; and for effluent SS, from 40-225 in a year. In Canada, most activated sludge treatment plants have a sample size of less than 40 in a year suggesting their annual true geometric means have not been accurately estimated. (Baker-IVI)
W86-00683

MUTAGENICITY ASSESSMENT OF DIFFERENT DRINKING WATER SUPPLIES BEFORE AND AFTER TREATMENTS,
Perugia Univ. (Italy). Cattedra di Igiene.
S. Monarca, R. Pasquini, and G. S. Sforzolini.
Bulletin of Environmental Contamination and Toxicology, Vol. 34, No. 6, p 815-823, June, 1985. 2 Tab, 21 Ref.

Descriptors: *Mutagenicity, *Drinking water, *Water analysis, *Water treatment, Water quality, Chlorination, Water distribution, Chlorinated hydrocarbons.

Three qualitatively different raw water supplies together with their correspondent chlorinated drinking waters were investigated for their mutagenic properties using the Salmonella microsome assay. A drinking water supply distributed through two different types of pipelines was chosen to study the effect of the distribution systems on water mutagenicity. A sequential liquid-liquid extraction at three different pHs and an in situ XAD-2 adsorption technique were used to prepare extracts and adsorbates from both untreated and treated water samples to compare mutagen recovery by these widely used methods. The in situ resin adsorption technique was unable to recover mutagens from all the water samples, while the liquid-liquid extraction technique gave extracts with mutagenic properties without metabolic activation for the two surface waters only after treatment. The appearance of direct acting mutagens after treatment of surface waters could be due to chlorination steps which allowed the chlorine to react with organic substances producing these potentially harmful compounds. The formation of chlorinated organics could be minimized, for instance, by avoiding prechlorination, chlorine concentrations higher than are necessary or by using alternative disinfectants. The liquid-liquid extraction technique showed higher recovery efficiency of mutagens from water samples. Extraction at different pHs gave useful indications about the chemical class of mutagens. Liquid-liquid extraction at pH 2 and testing of this extract by the Ames test with TA98 and TA100 strains is recommended for routine screening of mutagens in drinking water since acidic extracts contributed the major percentage to the total mutagenicity. (Baker-IVI)
W86-00690

ORGANOCHLORINE RESIDUES IN ANIMALS FROM THREE LOUISIANA WATERSHEDS IN 1978 AND 1979,
Louisiana State Univ., Baton Rouge. Dept. of Entomology.
For primary bibliographic entry see Field 5B.
W86-00691

EVIDENCE FOR POLYNUCLEAR AROMATIC HYDROCARBONS IN THE DIET OF BOTTOM-FEEDING FISH,
Roswell Park Memorial Inst., Buffalo, NY. Dept. of Experimental Biology.
For primary bibliographic entry see Field 5B.
W86-00694

MERCURY DISTRIBUTION IN A POLLUTED MARINE AREA. CONCENTRATIONS OF METHYL MERCURY IN SEDIMENTS AND SOME MARINE ORGANISMS,
Institut Rudjer Boskovic, Zagreb (Yugoslavia). Center for Marine Research.
N. Mikac, and M. Picer.
Science of the Total Environment, Vol. 43, No. 1-2, p 27-39, May, 1985. 3 Fig, 4 Tab, 34 Ref.

Descriptors: *Methyl mercury, *Water pollution, *Marine environment, *Sediments, *Marine animals, Kastela Bay, Adriatic Sea, Mercury compounds, Mussels, Fish, Monitoring,.

Methyl mercury concentrations were measured in various parts of Kastela Bay in the Central Adriatic, which is polluted with inorganic mercury. The values obtained, on a wet weight basis, for sediments were from 2 to 20 micro-g methyl mercury/kg; for the mussel Mytilus galloprovincialis from 10 to 110 micro-g/kg; and for various species of fish from 102 to 1448 micro-g/kg. The methyl mercury content increases by three orders of magnitude going from sediment to fish. The distribution of methyl mercury in relation to the depth of the sediment and the different organs of the mussel is presented. On the basis of the results obtained, it may be concluded that non-migratory species of fish are more suitable for methyl mercury monitoring in the marine environment than are sediment and mussels. (Author's abstract)
W86-00707

TESTING FOR THE TOXICITY OF CHEMICALS WITH TETRAHYMENA PYRIFORMIS,
Gifu Coll. of Medical Technology, Seki (Japan). Dept. of Hygiene.
Y. Yoshioka, Y. Ose, and T. Sato.
Science of the Total Environment, Vol. 43, No. 1-2, p 149-157, May, 1985. 5 Fig, 1 Tab, 9 Ref.

Descriptors: *Tetrahymena, *Toxicity, *Bioassay, Protozoa, Partition coefficient, Water analysis.

A test was developed using Tetrahymena pyriformis in order to determine the toxicity of various chemicals. Pre-cultured T. pyriformis was exposed for 24 h at 30 C to various concentrations of chemicals, and the number of T. pyriformis surviving were then counted. The concentration of the chemical, at which the proliferation of T. pyriformis was restricted to one-half of the blank test (EC50), was determined. The method, applied to 57 chemicals, demonstrated that it could be used to detect the chemicals at low concentrations rapidly and with ease. The EC50 values showed a good relationship with 48 h LC50 values for Himedaka (Orizias latipes), and could be explained on the basis of the partition coefficient between water and n-octanol. (Author's abstract)
W86-00711

EFFECTS OF STORAGE ON THE COMPOSITION OF MAIN COMPONENTS IN RAIN-WATER SAMPLES,
Royal Netherlands Meteorological Inst., De Bilt.
For primary bibliographic entry see Field 2K.
W86-00717

WET AND DRY DEPOSITION MONITORING IN SOUTHEASTERN MICHIGAN,
General Motors Research Labs., Warren, MI. Environmental Science Dept.
J. M. Dasch, and S. H. Cadle.
Atmospheric Environment, Vol. 19, No. 5, p 789-796, 1985. 4 Fig, 6 Tab, 11 Ref.

Descriptors: *Monitoring, *Wet deposition, *Dry deposition, *Michigan, Water pollution sources, Air pollution, Rain, Snow, Storms, Seasonal variation, Acid precipitation.

Wet and dry deposition as collected by a bucket were measured at two sites in southeastern Michigan for two years. The precipitation has an average pH of 4.27 and SO4(2-) to NO3(-) ratio of 2.0. Particulate dry deposition velocities of 0.6 cm/s for SO4(2-) and NO3(-) and > 2 cm/s for Cl(-), Ca(2+), Mg(2+), Na(+) and K(+) were calculated. The ambient particle composition, dry bucket collection and wet deposition were compared at two sites, one urban and the other rural. Higher ambient particle concentrations and dry deposition rates were measured at the urban site than the rural site, indicating the influence of local emissions. However, local emissions had no effect on the wet deposition concentrations. The influence of more distant source regions was examined by separating the precipitation events by wind direction. The events from the south and east had the highest SO4(2-) to NO3(-) ratios, which corresponded to the areas with the highest sulfur emissions. NO3(-) showed no directional dependence. Wet deposition was examined for the effect of storm type and seasonal trends. Contrary to a recent study on Long Island, higher concentrations of H(+), SO4(2-) and NH4(+) were found in winter rain compared to snow. The wet deposition concentrations of H(+), SO4(2-), and NH4(+) were highest in the summer, while only Na(+) and Cl(-) concentrations were highest in the winter, presumably due to winter road salting. The total deposition of acidic ions was highest in the summer and lowest in the winter, due both to low concentrations and lower precipitation volumes in the winter. The dry deposition as collected by a bucket accounted for 1% of total H(+) deposition, 21% of SO4(2-) deposition, 27% of NO3(-) deposition, 50% of Cl(-) deposition and 61% of Ca(2+) deposition. (Author's abstract)
W86-00719

USE OF WATERSHED CHARACTERISTICS TO SELECT CONTROL STREAMS FOR ESTIMATING EFFECTS OF METAL MINING WASTES ON EXTENSIVELY DISTURBED STREAMS,
Illinois Univ. at Urbana-Champaign. Dept. of Ecology, Ethology and Evolution.
For primary bibliographic entry see Field 5C.
W86-00725

AQUATIC BIOASSAY OF 11 PESTICIDES USING LARVAE OF THE MOSQUITO, WYEOMYIA SMITHII (DIPTERA: CULICIDAE),
Air Force Occupational and Environmental Health Lab., Brooks AFB, TX.

D. Strickman.
Bulletin of Environmental Contamination and Toxicology, Vol. 35, No. 1, p 133-142, July, 1985. 4 Fig, 1 Tab, 12 Ref.

Descriptors: *Pitcher plants, *Mosquitos, *Pesticides, *Larvae, *Bioassay, Assay, Toxicity, Water pollution effects, DDT, Heptachlor epoxide, Chloropyrifos, Malathion, Temephos, Carbaryl, Methomyl, Propoxur, Permethrin, Phenothrin, Resmethrin, Animal behavior.

The sensitivity of the pitcher plant mosquito assay to 11 pesticides representing four widely used groups was established; the assay detected the pesticides in water samples at levels within the ranges approximating with lethal concentrations of several fish species. The lowest concentrations of each pesticide affecting survival and development of larvae, respectively, were as follows (ppb): DDT (50, 50), heptachlor epoxide (10, 5), chlorpyrifos (1, 1), malathion (100, 100), temephos (5, 5), carbaryl (1,000, 1,000), methomyl (5,000, 1,000), propoxur (1,000, 500), permethrin (5, 1), phenothrin (20, 10), and resmethrin (100, 50). In many cases the lowest concentration detected was the lowest concentration used in the assay. The bioassay lasted for 7 days, and effects typically appeared between days 2 and 4. Behavioral signs of intoxication by pesticides included uncoordinated movement, jerky movement, difficulty unflexing, inactivity, and tonic contraction of longitudinal muscles resulting in shortening and thickening of larvae. All toxicants tested caused some or all of these signs, but consistent differences in signs were evident among pesticides, suggesting the possibility of using this assay in identification of pesticide contaminants. (Rochester-IVI)
W86-00733

ION CHROMATOGRAPH PROVIDES RAPID ANALYSIS OF AIR AND WATER,
P. Pecevich.
Pollution Engineering, Vol. 17, No. 3, p 53-55, March, 1985. 1 Fig, 1 Tab.

Descriptors: *Ion chromatography, *Water analysis, *Chromatography, Acid rain, Seawater, Iron, Cobalt, Nickel, Copper, Metals.

Ion chromatography easily measures several ions in a single analysis, and can measure trace amounts of one ion in the presence of large concentrations of other ions. This liquid chromatographic technique utilizes ion exchange resins as the means of separation and uses conductivity for detection and analysis of anions and cations. Because of its high degree of accuracy and reliability, ion chromatography has been designated by the Environmental Protection Agency (USA) as the method of choice for the analysis of acid rain. The ability of ion chromatography to resolve low concentrations of one or several inorganic anions in the presence of high concentrations of other inorganic ions makes it an ideal tool for the analysis of pollutants in sea water. Ion chromatography provides a fast, reliable, and accurate technique to monitor potential pollutants, such as iron, copper, nickel, and cobalt in industrial process wastes, prior to discharge into the environment, or to analyze samples from contaminated areas. A complete anion and cation profile can be obtained in less than 20 min with low ppb detection limits. (Rochester-IVI)
W86-00768

SORPTIVE CAPACITY OF AN AQUATIC MACROPHYTE FOR THE PESTICIDE AMINOCARB,
Ottawa Univ. (Ontario). Dept. of Biology.
P. Weinberger, and R. Greenhalgh.
Journal of Environmental Science and Health, Vol. B20, No. 2, p 263-273, April, 1985. 2 Fig, 14 Ref. NSERC grants GO-204 and A1737.

Descriptors: *Sorption, *Macrophytes, *Aminocarb, *Insecticides, *Hornwort, Aquatic plants, Pesticides, Water pollution effects, Fate of pollutants.

Hornwort (Ceratophyllum demersum) was exposed to a constant 1 micro-g/ml aminocarb concentration for an experimental period of 300-450 h. The concentration of aminocarb in the plant tissue and surrounding water was constantly monitored. Hornwort exhibited a large capacity for the sorption of the pesticide - up to 400 micro-g/g fresh weight in the dark and 1000 micro-g/g fresh weight in the light. Smaller, actively growing sprigs sorbed 5 times more pesticide per gm fresh weight than larger, older sprigs, although total uptake per plant was greater in the larger plants. Incipient necrosis became evident in treated plants after 72 h in the dark and after 312 h in the light while untreated controls remained healthy for the entire period. In living plants, light was a significant factor in increasing the sortptive capacity of the plant. Younger sprigs, with a higher ratio of lear sorptive surface to internodal stem per g fresh wt, provided the largest sink for the pesticide. Membrane conformation and integrity appear to be important factors in determining the capacity of this aquatic plant for pesticide sorption. Because of its large sorptive capacity, Hornwort may provide a good non-target species for monitoring residual pesticides in an aquatic environment. (Collier-IVI)
W86-00812

SULFATE DETERMINATION IN INDUSTRIAL WASTEWATER BY LIQUID CHROMATOGRAPHY WITH POSTCOLUMN SOLID-PHASE REACTION DETECTION,
Proefstation voor Aardappelverwerking, Groingen
K. Brunt.
Analytical Chemistry, Vol. 57, No. 7, p 1338-1341, June, 1985. 4 Fig, 5 Tab, 19 Ref.

Descriptors: *Sulfates, *Industrial wastewater, *Liquid chromatography, *Reaction detection, Potato starch industry, Pollutant identification, Chemical analysis, Chromatography.

A sulfate selective postcolumn solid-phase reactor (SPR) detection system is described for sulfate determination at parts per million (ppm) levels in potato starch industry wastewaters. The effect of the chromatographic flow rate on the conversion reaction in the SPR is discussed. The linear dynamic range of the detection system in combination with the used anion-exchange separation is from about 5 to 400 ppm. The repeatability of the system at the 30 ppm sulfate level is better than 3.5%. The SPR system can be used for about 13 h without noticeable depletion effects. Day-to-day repeatability is good. Application of the described detection system for the sulfate determination industrial wastewaters is discussed. Recoveries in spiked wastewater samples were better than 90%. (Author's abstract)
W86-00819

EXTRACTION AND ENRICHMENT OF CHLORINATED PHENOLS FROM SURFACE WATERS FOR THE DETERMINATION BY CAPILLARY-GC/FTIR-SPECTROSCOPY,
Johannes Kepler Univ., Linz (Austria).
H. Malissa Jr., G. Szolgyenyi, and K. Winsauer.
Fresenius's Zeitschrift fur Analytische Chemie, Vol. 321, No. 1, p 17-26, May, 1985. 5 Fig, 3 Tab, 48 Ref. Osterreichischr Fonds zur Forderung der wissenschaftlichen Forschung grant 4807.

Descriptors: *Water analysis, *Chlorinated phenols, *Fourier-transform infrared spectroscopy, *Gas chromatography, Chromatography, Spectroscopy, Phenols.

A method is presented for the separation and substance-specific determination of chlorinated phenols at trace level in surface waters using capillary-GC/FTIR-spectroscopy. Since an injected amount of at least 100 ng is required to obtain well-structured IR spectra, the extraction and enrichment procedure must provide a concentration factor of 10,000 and simultaneously high recoveries. The separation of the complete range of chlorinated phenols was performed without derivatization on a SE54 fused silica WCOT column; the degree of decrease in separation efficiency introduced by the FTIRS detection system is discussed. The applicability of an on-column injection technique using a thermodesorption-and cold trap injector with solvent removal was tested, which allows the injection of large volumes of concentrate. Proceeding from 1 l water volume and a 10 ppb concentration level the chlorophenols were correctly identified by their IR spectra; mean recovery was in the 90% range. The possibility of obtaining information on the identity of matrix components based on IR data only is discussed. (Author's abstract)
W86-00824

SEPARATION AND DETERMINATION OF SELENIUM(IV) IN ENVIRONMENTAL WATER SAMPLES BY AN ANION-EXCHANGE RESIN MODIFIED WITH BISMUTHIOL-II AND DIAMINONAPHTHALENE FLUOROPHOTOMETRY,
Nagoya City Environmental Pollution Research Inst. (Japan).
K. Itoh, M. Nakayama, M. Chikuma, and H. Tanaka.
Fresenius's Zeitschrift fur Analytische Chemie, Vol. 321, No. 1, p 56-60, May, 1985. 5 Fig, 4 Tab, 8 Ref.

Descriptors: *Selenium, *Anion-exchange resins, *Bismuthiol-II, Diaminonaphthalene fluorophotometry, *Resins, *Water analysis, Chemical analysis, Metals, Fluorometry, Tellurium coprecipitation.

Selenium(IV) in environmental water samples was determined fluorometrically following its collection by the use of a new functional resin. The resin was easily prepared from an anion-exchange resin by modification with bismuthiol II. The novel method comprises a combination of the preconcentration with bis II resin and the conventional fluorometry with 2,3-diaminonaphthalene-cyclohexane (DAN). A highly selective adsorption of selenium(IV) was achieved by the formation of stable selenotrisulfide from bismuthiol II and selenium(IV) on the resin. The method was successfully employed for the determination of Se in river water and waste water. The adsorption of selenium(IV) on bis II resin is hardly affected by organic compounds; the tellurium coprecipitation method with ascorbic acid is affected by organic compounds. The method is advantageous for the treatment of environmental samples in the field because selenium can be collected on the resin and adsorbed selenium is very stable and can be stored for determination in the laboratory. (Collier-IVI)
W86-00825

EXTENT OF MONOCHLORAMINE INTERFERENCE IN THE DPD COLORIMETRIC METHOD FOR FREE CHLORINE IN WATER,
Paris-5 Univ. (France). Lab. d'Hydrologie.
N. Strupler.
Journal of the Institution of Water Engineers and Scientists, Vol. 39, No. 2, p 134-136, April, 1985. 1 Fig, 2 Tab, 4 Ref.

Descriptors: *Monochloramine, *Diethyl-p-phenylene-diamine, *Colorimetry, *Chlorine, Chemical analysis, Water analysis, Reagents, Iodometry.

If standard procedures are followed, that is, obtaining free available chlorine (FAC) readings without a standing period, preferably well within 1 min, coupled wth strict adherence with approved reagent specifications, the interference by levels of monochloramine normally encountered becomes insignificant. Diethyl-p-phenylene-diamine (DPD) results in this way compared favorably with determinations by iodometry. At 21 C, positive FAC errors of 2.6% of the monochloramine concentration per minute were observed when standard reagents were used. In a comparison of standard reagents with non-standard reagents which lacked interference suppressing agents, the nonstandard agents gave considerably larger apparent FAC readings (4.0-9.0% of initial monochloramine content). When 1 minute was allowed to elapse after adding reagents before taking readings, the monochloramine interference for standard reagents was 1.3% at 10 C, 2.6% at 19/20 C, and 3.3 at 26 C in terms of initial monochloramine concentration. (Rochester-IVI)
W86-00833

FIELD-USE OF DISSOLVED OXYGEN ELECTRODES,
Southern Illinois Univ. at Carbondale. Dept. of Geography.
C. W. Prowse.
Journal of Institution of Water Engineers and Scientists, Vol. 39, No. 2, p 179-183, April, 1985. 1 Fig, 23 Ref.

Descriptors: *Dissolved oxygen, *Electrodes, *Field tests, Nomograms, Calibrations, Mathematical equations, Measuring instruments, Water analysis.

During a recent three year study of urban storm water quality, which involved sampling waters often heavily polluted or charged with organic suspended solids, a membrane oxygen electrode and meter were employed for field determinations. The probe and meter both performed well but two problems were identified: There is a measure of uncertainty as to which of several calibration methods were most appropriate to field-use; and, calculation procedures need improvement. Calibration procedures need to be standardized and more closely evaluated, to maintain instrument precision and data comparability. More rapid and convenient calculation procedures are required to obviate the need for commonly used nomograms. A mathematical relationship was derived to undertake the conversion to mg/l. For all practical purposes, the equation obviates the need for the nomogram over the full range of dissolved oxygen concentrations likely to be encountered in natural fresh waters. The equation allows the use of pocket calulators for field use or the use of a main-frame computer in which all primary data may be stored and conversion may be programmed. Although modified Winkler methods most accurately determine dissolved oxygen levels in water in the laboratory, electrodes retain the advantages of field portability, rapidity of use and insensitivity to interferences. (Collier-IVI)
W86-00837

CARBON ADSORPTION ISOTHERM TEST FOR VOLATILE ORGANIC CHEMICALS IN WATER,
R. W. Schneiter, J. Dragun, and T. W. Kalinowski.
Journal of the Water Pollution Control Federation, Vol. 57, No. 5, p 403-405, May, 1985. 1 Fig, 1 Tab, 4 Ref.

Descriptors: *Organic compounds, *Volatile compounds, *Carbon adsorption isotherm test, Water analysis, Activated carbon, Isotherms.

A protocol is presented for conducting batch isotherm tests with mixtures of volatile organic compounds in water in such a way as to account for chemical losses from volatilization. Several important modifications to the ASTM standard were necessary to control and measure volatilization losses, as follows: (1) the activated carbon mass range is estimated from pure solute isotherm data, to bracket the anticipated range of carbon effectiveness based on known raw water quality, (2) completely filled glass bottles with airtight, teflon-sealed caps are substituted for stoppered flasks, (3) bottles are agitated for 24 hr instead of 2 hr, (4) samples are not filtered; a minimum of 4 hr settling replaces filtration, and (5) sample controls are used to measure volatilization losses. This protocol has been used as a preliminary step in actual groundwater remedial action projects where design of granular activated carbon absorption equipment has been evaluated. Isotherms for individual, key contaminants or for aggregates of multiple contaminants have been prepared to evaluate carbon treatment effectiveness and to compare different carbons for further study or application. (Rochester-IVI)
W86-00845

SHORT-TERM TEST FOR PREDICTING THE POTENTIAL OF XENOBIOTICS TO IMPAIR REPRODUCTIVE SUCCESS IN FISH,
Swedish Environmental Research Inst., Stockholm.
L. Landner, A. H. Neilson, L. Sorensen, A. Tarnholm, and T. Viktor.
Ecotoxicology and Environmental Safety, Vol. 9, No. 3, p 282-293, June, 1985. 6 Fig, 2 Tab, 21 Ref.

Descriptors: *Bioassay, *Fish, *Toxicity, *Reproduction, Anadromous fish, Fish migration, Spawning, Immature growth stages, Water pollution effects, Mortality, Hatching, Zebra fish.

Short-term screening tests with the zebra fish (Brachydanio rerio) have been developed for predicting the potential of xenobiotics to impair reproductive success in fish. The aim was to find simple and sensitive test parameters and to simulate exposure situations typical for anadromous fish species (salmonids), which generally cross heavily polluted coastal areas or estuaries before they reach uncontaminated upstream spawning areas. Therefore, particular attention was directed to tests designed to assess adverse effects induced during gametogenesis in adult fish. The test protocol involves exposure of adults prior to, but not during, spawning and the effects are measured in the offspring as alterations in hatching frequency and hatching rate of eggs, and survival and stress tolerance of embryos and larvae. Some representative examples of the application of these tests are given, and it is some that impairment of reproductive success can be induced by exposure of parent fish prior to spawning at concentrations of xenobiotics at least five times lower than those yielding effects during exposure of embryos and larvae. It is suggested that, in hazard assessment programs, tests of the effect of xenobiotics on the offspring of preexposed adults be routinely incorporated. (Author's abstract)
W86-00874

5B. Sources Of Pollution

MODEL OF SULPHATE CONCENTRATION IN A SMALL STREAM IN THE HARP LAKE CATCHMENT, ONTARIO,
Oslo Univ. (Norway). Dept. of Chemistry.
H. M. Seip, R. Seip, P. J. Dillon, and E. de Grosbois.
Canadian Journal of Fisheries and Aquatic Sciences, Vol. 42, No. 5, p 927-937, May, 1985. 4 Fig, 3 Tab, 28 Ref.

Descriptors: *Sulfates, *Streams, *Mathematical models, *Acid rain, *Harp Lake Catchment, *Ontario, Soil chemistry, Oxidation, Solubility, Snowmelt, Catchment area, Sulfur.

The causes of the recent acidification of surface waters in several parts of the world are still a matter of considerable controversy. A better understanding of the acidification mechanisms can be obtained by a combination of field studies and mathematical modelling. A complete model would require very extensive information about the catchment (e.g. precipitation, water chemistry, soil chemistry, vegetation). Very few, if any, data sets in existence satisfy these requirements. A model previously used for Norwegian catchments was modified to predict discharge and sulfur concentration in a stream draining a small catchment in Ontario. The annual input of sulfur roughly balances the output, the average sulfur flux being about 1.6 g S/sq m/yr. The average dry deposition was estimated to be about 0.4 g S/sq m/yr. For good agreement between calculated and observed sulfur concentrations, it was necessary to introduce a reduction (or adsorption) process for sulfate in deeper soil layers during summer and fall. During dry periods, however, sulfate is produced by oxidation in the upper soil layer. The sulfate concentrations in streamwater during snowmelt are remarkably constant. According to model results this could be explained by the existence of a reservoir of easily soluble sulfur in the soil considerably larger than the annual sulfur flux. The basic structure of the models applied to the Ontario stream and to two streams in Norway was the same. It seems likely, therefore, that the model may, with moderate modifications, be applicable to many catchments. (Author's abstract)
W86-00629

CHEMICAL STUDY OF THE SHOHOLA CREEK HEADWATERS, PIKE COUNTY, PENNSYLVANIA,
East Stroudsburg Univ., PA. Dept. of Chemistry.
R. Davis, and C. Y. Cheng.
Proceedings of the Pennsylvania Academy of Science, Vol. 58, No. 2, p 202-206, 1984. 6 Fig, 1 Tab, 8 Ref.

Descriptors: *Shohola Creek, *Pike County, *Pennsylvania, *Chemical analysis, Water analysis, Alkalinity, Hardness, Water properties, Highways.

Factors that contribute to the overall inorganic water quality and the possible effects of Interstate 84 which lies near the Shohola Creek were investigated. The Shohola Creek is located in southeastern Pike County in northeastern Pennsylvania. It is a spring fed creek that starts in the woods and flows into the Delaware River at Shohola. The chemical analyses of the waters revealed a pH which decreased from a high of 7.41 to a low of 6.76 over the test period while the alkalinity shows a gradual increase. Hardness, phosphate-phosphorus, and nitrate-nitrogen showed similar increases. Manganese and iron concentrations were very low and the lead concentrations were almost all negligibly low. During the test period the overall inorganic water quality seemed not be affected by the heavy traffic on Interstate 84, which lies nearby. (Baker-IVI)
W86-00636

USING SIMULATION TO ASSESS THE IMPACTS OF CONSERVATION TILLAGE ON MOVEMENT OF SEDIMENT AND PHOSPHORUS INTO LAKE ERIE,
Purdue Univ., Lafayette, IN. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 4D.
W86-00650

STUDIES OF WATER POLLUTION OF THE RIVER CAUVERY - PHYSICO-CHEMICAL CHARACTERISTICS,
Bangalore Univ. (India). Dept. of Botany.
R. K. Somashekar.
International Journal of Environmental Studies, Vol. 24, No. 2, p 115-123, 1985. 4 Fig, 5 Tab, 10 Ref.

Descriptors: *Water analysis, *River Cauvery, *India, *Physicochemical characteristics, Seasonal variations, Anions, Cations, Agricultural chemicals, Fate of pollutants, Water pollution.

An attempt was made to understand the chemical characteristics of surface waters of the river Cauvery and to correlate the chemical concentration and loads in the river as a function of hydrological parameter, viz. water discharge. Water samples from the river Cauvery, Karnataka, India were collected from three stations located over a distance of 20 km: Station 1 was near Krishnarajasagar dam; Station 2 was located at the point of discharge of effluents from paper and fertilizer factories; Station 3 was located near the confluence of the Cauvery and Kapila rivers. Monthly and seasonal variations in major cations and anions were significant. The regression analysis of transported ions, silica and alkalinity varied with the quantity of river flow and yielded a linear relationship. The transported dissolved load of chemical constituents increased with the discharge, but the concentrations of all the constituents, except silica, calcium and iron, were inversely correlated with the stream discharge at all the stations. The rate of increase of the dissolved load with river discharge is slower for the constituents which are inversely related to discharge, with a significant negative correlation index. The sources of dissolved chemical constituents in the river water of all three stations are most likely the weathering of rocks, minerals and soils in the catchment area. The addition of water from the nearby agricultural fields and of domestic wastes are responsible for variations in some of the parameters, especially at station 2. A short-term investigation into the hydrology of the river water can demonstrate the general trends that exist in the area. (Baker-IVI)

W86-00657

ANALYSIS OF PRECIPITATION CHEMISTRY DATA FROM ALASKA,
National Oceanic and Atmospheric Administration, Rockville, MD. Air Resources Lab.
For primary bibliographic entry see Field 2K.
W86-00659

ACIDIFICATION OF SOUTHERN APPALACHIAN LAKES,
Clemson Univ., SC. Dept. of Environmental Systems Engineering.
R. W. Talbot, and A. W. Elzerman.
Environmental Science and Technology, Vol. 19, No. 6, p 552-557, June, 1985. 2 Fig, 2 Tab, 21 Ref. Department of the Interior grant B-151-SC and NSF grant ISP-8011451.

Descriptors: *Acidification, *Lakes, *Appalachians, *Acid rain, Atmospheric deposition, Chemical properties, Alkalinity, Watersheds, Soil chemistry, Weathering, Reservoirs.

Measurements of the dissolved (< 0.4 micro-m) major element water chemistry of 10 lakes and reservoirs situated in the southern Appalachian Mountain and Carolina Peidmont regions are used to examine effects of acidic atmospheric deposition inputs on water chemistry. In the mountain region, lakes with low alkalinity and a small watershed/lake area ratio appear to be most susceptible to, and may be undergoing, pH reduction. In the Piedmont region, watershed soils, especially those exposed by man's activities, appear to be effectively neutralizing acid inputs. Weathering of rocks and soils accelerated beyond that expected from carbonic acid alone is probably occurring in the mountain and Piedmont systems. The analysis suggests that reduction of lake water pH, mobilization of soil chemical constituents, and subsequent changes in the chemical composition of aquatic systems may be a more widespread and potentially serious environmental problem in this area than previous analyses have suggested. (Author's abstract)
W86-00663

FATE AND EFFECTS OF ORGANOTIN COMPOUNDS,
California Univ., Berkeley. Dept. of Zoology.
R. B. Laughlin, and O. Linden.
Ambio, Vol. 14, No. 2, p 88-94, 1985. 8 Fig, 60 Ref.

Descriptors: *Fate of pollutants, *Organotin compounds, *Tin compounds, Organic compounds, Toxicity, Bioaccumulation, Antifouling paints, Water pollution effects.

The increasing use of organotin compounds may produce environmental problems of both magnitude and duration. At present, additional data are needed to predict with confidence the possible environmental effects posed by these compounds. This review showed that while knowledge is advancing rapidly, there remain serious gaps. In particular, the difficulty of chemical analyses of these compounds poses problems answering questions about biological effects. Nevertheless, it is clear that early information about their lack of toxicity, mode of action and rapid rate of degradation in the environment is inaccurate or only partially correct. Given the enormous number of potential chemical structures possible, modern structure-toxicity quantification is being studied. This information, it is hoped, may be used prior to the appearance of problems. Bioaccumulation potential, as indicated by octanol-water partition coefficients, is large and may prove particularly detrimental to nearshore seafood resources. The use of effective copolymer antifouling paints with low triorganotin release rates is to be encouraged to minimize these problems. Efforts to monitor and control effluents should take into account not only primary constituents, but also redistribution products and impurities since they, proportionally, may be present in low but acutely toxic concentrations. It will only be by prudent use that the benefits of organotins will be maximized and risks minimized. (Baker-IVI)

W86-00665

POTENTIALLY TOXIC BLUE-GREEN ALGAE (CYANOBACTERIA) IN FINNISH NATURAL WATERS,
Helsinki Univ. (Finland). Dept. of Limnology.
P.-E. Persson, K. Sivonen, J. Keto, K. Kononen, and M. Niemi.
Aqua Fennica, Vol. 14, No. 2, p 147-154, 1984. 1 Fig, 7 Tab, 33 Ref.

Descriptors: *Cyanophyta, *Toxins, *Finland, *Coastal waters, Lakes, Toxicity, Phytoplankton, Eutrophication, Water pollution sources.

Blue-green algal blooms in natural waters may result in severe ecological and practical problems, as several species of blue-green algae are capable of producing toxins. The occurrence of potentially toxic blue-green algae in Finland was examined. The survey was restricted to species associated with acute cases of poisoning, typical of exotoxins (hepatotoxins, neurotoxins). The number of samples on record was 5288. Thirteen percent of the samples from freshwaters and one third of the samples from coastal waters contained noteworthy concentrations of potentially toxic blue-green algae. A case of dog poisoning is also reported which resembled the outbreaks in Denmark and Sweden in 1975 and 1982, respectively. The existence of a toxic blue-green algal strain in Lake Vesijarvi is also noted. (Baker-IVI)
W86-00674

POLLUTION LOADINGS FROM FINNISH INLAND FISH-FARMS: A CASE STUDY,
Kuopio Univ. (Finland). Dept. of Occupational and Industrial Hygiene.
E. Parjala, A. Tamminen, and O. V. Lindqvist.
Aqua Fennica, Vol. 14, No. 2, p 205-214, 1984. 13 Fig, 2 Tab, 22 Ref.

Descriptors: *Water pollution sources, *Fish farming, *Finland, Nitrogen, Phosphorus, Phosphates, Aquaculture, Pollution load, Suspended solids, Sludge, Fate of pollutants.

Pollution loadings were studied from a fish-farm in Central Finland producing annually about 200 tons of rainbow trout. The farm has 34 separate ponds with total surface area of 55,800 sq m. Average depth of the ponds and raceways is about one meter. The retention time of the water at the farm was 5 to 8.5 hours. The farm used 25-30% of the water flow of the nearby river. The effluents on the farm had total phosphorus concentrations of 34-120 micro-g/l, total nitrogen concentration of 580-1300 micrg-g/l, suspended solids concentration of 1-9 mg/l and BOD7 of 2.3-5.1 mg oxygen/l. Pollution loadings of the farm were 9.0 to 20.5 gP/kg of fish, 6.0-9.7 gP/kg of feed, 48-108 gN/kg of fish, 26-170 gN/kg of feed, 3.1-19.4 gSS/kg of fish, 5.2-19.5 gSS/kg of feed, 0.2-0.7 g BOD/kg of fish and 0.4-1.1 g BOD/kg of feed. More than 50% of the total phosphorus and more than 70% of the nitrogen in the effluents was soluble. Almost all the phosphorus loading caused by the farm consisted of phosphate-P. The main part of the nitrogen loading consisted of ammonia-N and organic nitrogen compounds. Phosphorus and nitrogen leach very quickly and effectively from the sludge which gathers on the bottom of the raceways. The sludge should be removed once or twice a week from the bottom of the raceways to effectively decrease phosphorus and nitrogen loadings. (Baker-IVI)
W86-00680

MERCURY CYCLE IN LAKES; SOME NEW HYPOTHESES,
National Board of Waters, Helsinki (Finland). Water Research Inst.
M. Verta.
Aqua Fennica, Vol. 14, No. 2, p 215-221, 1984. 3 Fig, 3 Tab, 51 Ref.

Descriptors: *Mercury, *Fate of pollutants, *Organomercury compounds, *Fish physiology, *Bioaccumulation, Temperature effects, Water quality, Acidity, Bacteria, Heavy metals, Metals.

Factors influencing the content of methyl mercury in freshwater biota can be listed as: the amount of methyl mercury to which the organism is exposed, and factors which affect the methylation of mercury or the accumulation of methyl mercury in biota such as temperature, water quality, bacterial activity, size, age, sex, and metabolic differences. Thus the mercury content of freshwater biota varies greatly between individuals of a single species from different environments, even if they were subjected to the same level of contamination. In a study of 35 forest lakes the methyl mercury content in pike was correlated better with the water quality parameters describing the allochtonous organic matter content in the lake than with pH and trophic level. In a typical freshwater lake more than 90% of the mercury that can be methylated and can enter the food chain is in the upermost 5 cm of the bottom sediments and only about 1% is in the fish population. Once assimilated into fish, methyl mercury is bound very strongly to the tissues. When a fish is eaten by a predatory fish the assimilation efficiency for naturally accumulated methyl mercury is only 10-20%. Most of the methyl mercury eaten is excreted in feces. Because the fish population contains such a large fraction of the total amount of methyl mercury, intensive fishing can effectively decrease the amount of methyl mercury cycling in lake biota. This could lead to the decrease of methyl mercury concentrations in fish if the fish population reacts to fishing with more rapid growth. Whatever the impact of fishing on the methyl mercury concentration of fish, it is evident that only with quantitative estimations of methyl mercury amounts in biota, especially in fish populations, can an understanding be gained of the mercury cycle in lakes. (Baker-IVI)
W86-00681

QUALITY OF RUNOFF WATER FROM FINNISH FUEL PEAT MINING AREAS,
Helsinki Univ. (Finland). Dept. of Limnology.
T. Sallantaus.
Aqua Fennica, Vol. 14, No. 2, p 223-233, 1984. 7 Fig, 4 Tab, 22 Ref.

Descriptors: *Water pollution sources, *Peat, *Mining, *Drainage, Acidity, Water quality, Suspended sediments, Chemical oxygen demand, Organic carbon, Bogs, Mires.

A fuel peat mining area with well decomposed peat exposed at the surface is susceptible to erosion. This must be taken into account when planning the peat mining area and measures for reducing the loading of watercourses due to peat mining. The great volume of ditch network should be used as short time storage for runoff water after heavy rains to promote settling of suspended solids. This could be achieved by constructions in the main ditches, which automatically dam water when a certain runoff rate is reached. The effect of such constructions depends greatly on the slope of main ditches and lower parts of field ditches above the construction. These construction should be supplemented by sedimentation basins, which must be situated before mixing with waters from outside the peat mining area takes place, either in the main ditches or at the end of each field ditch. The quantitative changes in the discharge of dissolved organic matter due to peat mining seem to be rather small once the depletion of water storage after drainage has taken place. More attention should be paid to qualitative changes. The acidity of runoff waters from oligotropic peatlands seems to be reduced in many cases after drainage and peat mining and it seems that neutralization of drainage waters, as has sometimes been suggested, is not normally needed. (Baker-IVI)
W86-00682

DISTRIBUTION OF HEAVY METALS IN WATER AND SEDIMENTS OF SELECTED SITES OF YAMUNA RIVER (INDIA); ENVIRONMENTAL MONITORING OF THE YAMUNA RIVER - PART I,
Aligarh Muslim Univ. (India). Environmental Research Lab.
M. Ajmal, M. A. Khan, and A. A. Nomani.
Environmental Monitoring and Assessment, Vol.

5, No. 2, p 205-214, June, 1985. 1 Fig, 3 Tab, 34 Ref.

Descriptors: *Yamuna River, *India, *Metals, *Sediments, *Water pollution, Water analysis, Carbonates, Copper, Cadmium, Chromium, Iron, Manganese, Nickel, Lead, Zinc, Phosphorus, Industrial wastes, Domestic wastes, Pesticides.

The impact of domestic and industrial effluents on the concentrations of Cd, Cu, Co, Cr, Fe, Mn, Ni, Pb and Zn metals in water and sediments of the Yamuna river was studied at various sampling stations. The mechanism of sedimentation of metals through organic matter, calcium carbonate, and pH was also considered. This study covers a distance of about 840 km and five big cities, namely Delhi, Mathura, Agra, Etawah, and Allahabad. Variation in the concentrations of the elements from one sampling station to another may be due to the variation in the quality of industrial and sewage wastes being added to the water at different points. Sediments of the Yamuna river contained 2.1-5.2% calcium carbonate, a high quantity. The precipitation of a number of metals in the presence of such a high carbonate concentration is obvious. The highest concentrations of iron and manganese in the sediments were detected at Agra and Mathura, 8387.0-9636.0 micro-g/g and 521.0-558.0 micro-g/g, respectively. At Agra a number of iron foundries are situated which directly inject their effluents into the river. Chromium and nickel ranged from 8.60-199.35 micro-g/g and 4.72-39.5 micro-g/g, respectively. Maximum chromium was found at Mathura and maximum nickel values at Delhi. The amount of organic matter was highest at Agra followed by Delhi and Mathura, probably due to the high organic pollution by sewage and synthetic organic pollutants disposed off from these cities. Phosphorus was in the range of 290.0-870.0 mg/kg in the river sediments. This high level may be due to the cremation of dead bodies on the banks of the river and throwing of the ashes into it. Another reason may be the excessive use of organophosphorus pesticides which utimately reach the river through runoff. (Baker-IVI)
W86-00685

ZINC DEPOSITION IN ACID LAKES: THE ROLE OF DIFFUSION,
Institut National de la Recherche Scientifique, Sainte-Foy (Quebec).
R. Carignan, and A. Tessier.
Science, Vol. 228, No. 4707, p 1524-1526, June, 1985. 1 Fig, 2 Tab, 23 Ref.

Descriptors: *Zinc, *Diffusion, *Acid lakes, *Sediment-water interfaces, *Lake sediments, *Clearwater Lake, *Ontario, *Tantare Lake, *Quebec, Trace metals, Lakes, Acidity, Fate of pollutants.

The relative importance of the diffusion mechanism has been investigated in two lakes by comparing the present-day rates of zinc accumulation to the calculated diffusive fluxes across the sediment water interface. Duplicate sediment cores were obtained at a depth of 20.2 m in Clearwater Lake, Ontario and at 15.5 m in Tantare Lake, Quebec. The sediment Zn(t) profiles show a maximum at 2.5 to 3.5 cm, with a nearly linear decrease to a constant level at 9 to 10 cm. Such profiles are common in acid lakes. In Tantare Lake, a recent increase in sediment deposition is very unlikely as the lake's watershed has not been disturbed by forest fire, road construction, or wood harvesting for at least the last 100 years. In Clearwater Lake, sediment deposition may have recently increased owing to the extensive deforestation of the watershed 40 to 50 years ago from smelter sulfur dioxide emissions. The transport of trace metals from the water column to the sediments has generally been regarded as a sedimentation process controlled by the extent of trace metal association to the suspended solids and by the rate of sedimentation of the suspended solids. Present results suggest that such a model may not be applicable for zinc in acid lakes, and perhaps for other elements that are present in the water column in relatively high concentrations but are efficiently scavenged in the sediments. Because of the nonsteady state nature of anthropogenic zinc influx in lakes, it may be advisable to use nonsteady-state numerical methods in the interpretation of sedimentary zinc profiles and in the modeling of the early diagenesis of this element and other transition metals in acid lakes. (Baker-IVI)
W86-00689

ORGANOCHLORINE RESIDUES IN ANIMALS FROM THREE LOUISIANA WATERSHEDS IN 1978 AND 1979,
Louisiana State Univ., Baton Rouge. Dept. of Entomology.
P. F. Dowd, G. U. Mayfield, D. P. Coulon, J. B. Graves, and J. D. Newsom.
Bulletin of Environmental Contamination and Toxicology, Vol. 34, No. 6, p 832-841, June, 1985. 6 Tab, 7 Ref. U.S. Department of the Interior, Patuxent Wildlife Research Center contract 14-16-0009-77-950.

Descriptors: *Chlorinated hydrocarbons, *Louisiana, *Lake Verret, *East Franklin, *Bayou Plaquemine-Brule, *Pesticides, *Water pollution effects, *Animal tissues, Fate of pollutants, Fish, Crustaceans, Mammals, Birds, Insecticides, Heron, Raccoons, Shad, Catfish, Crappie, Frogs, Crawfish, Benzene hexachloride, Chlordane, Compound E, DDD, DDT, DDE, Dieldrin, Endrin, Heptachlor, Polychlorinated biphenyls, Nonachlor, Toxaphene.

Organochlorine pesticide residues were detected in some, but not all, samples of animal tissue obtained three sites in Louisiana. The sites reflected different levels of pesticide use: East Franklin, formerly heavy organochlorine insecticide use; Bayou Plaquemine-Brule, intermediate insecticide use; and Lake Verret, low insecticide use. Samples of yellow-crowned night heron (Nyctanassa violacea) water snakes (Natrix spp.), raccoons (Procyon lotor), shad (Dorosoma spp.), channel catfish (Ictalurus punctatus), crappie (Pomoxis spp.), frogs (Rana spp.) and crawfish (Procambarus clarkii) were obtained in 1978 and 1979. Chromatographic methods were used for detection of alpha- and beta-benzene hexachloride, alpha- and gamma-chlordane, compound E, DDD, DDE, DDT, dieldrin, endrin, heptachlor, polychlorinated biphenyls (PCBs) trans- and cis-nonachlor, and toxaphene. The compounds most frequently found as residues in catfish whole body, crappie, shad, and heron were DDE, dieldrin, and PCBs in samples from the Lake Verret site. DDE and dieldrin generally declined from 1978 to 1979, but levels of PCBs stayed approximately the same or increased during this period. The compounds most frequently encountered as residues in samples from catfish whole body, heron, shad, crappie, crawfish, and snakes at the Plaquemine-Brule site were chlordane isomers, DDE, and PCBs. While DDE and chlordane tended to decline from 1978-1979, PCBs remained the same or increased. At the East Franklin site, residues from catfish whole body, crappie, heron, and shad primarily consisted of DDE and PCBs, except for shad, which had residues of several compounds in 1978. DDE levels declined in all types of samples except shad from 1978 to 1979; PCBs remained fairly constant. Heron and shad are apparently the species most likely to accumulate organochlorine residues, regardless of contamination level at the site of collection, which allows them to serve as indicator species for organochlorine contamination in Louisiana. (Rochester-IVI)
W86-00691

METABOLISM OF ALDRIN BY THE FRESHWATER PLANARIAN PHAGOCATA GRACILIS,
Middle Tennessee State Univ., Murfreesboro. Dept. of Biology.
For primary bibliographic entry see Field 5C.
W86-00693

EVIDENCE FOR POLYNUCLEAR AROMATIC HYDROCARBONS IN THE DIET OF BOTTOM-FEEDING FISH,
Roswell Park Memorial Inst., Buffalo, NY. Dept. of Experimental Biology.
A. E. Maccubbin, P. Black, L. Trzeciak, and J. J. Black.
Bulletin of Environmental Contamination and Toxicology, Vol. 34, No. 6, p 876-882, June, 1985. 3 Fig, 2 Tab, 17 Ref.

Descriptors: *Fish, *Polynuclear aromatic hydrocarbons, *Fish food, *Stomachs, *Lake Erie, Hydrocarbons, Suckers, Fluoranthene, Sediments, Flourene, Phenanthrene, Anthracene, Fluoranthene, Pyrene, Benzanthracene, Chrysene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Benzo(a)pyrene, Dibenz(a,h)anthracene, benzo(g,h,i)perylene, indeno(1,2,3-c,d)pyrene.

High Pressure liquid chromatography studies of stomach contents of white suckers (Catastomus commersoni) collected at three sites in eastern Lake Erie (USA) demonstrated the presence of substantial concentration of polyaromatic hydrocarbons (PAH). Samples collected at Crescent Beach ('clean') and 18 Mile Creek ('relatively clean') had similar chromatographic profiles, although concentrations of certain PAHs differed. The profile from Smokes Creek ('polluted') had more PAH, and generally at higher concentrations, with the exception of 731.84 nanogram/g wet wt fluoranthene at Crescent Beach. Sediment from Smokes Creek had a chromatographic PAH profile similar to that observed for fish stomach contents from that site, with each individual peak resolved, in the sediment but at higher concentrations. Compounds identified in this study were fluorene, phenanthrene, anthracene, fluoranthene, pyrene, benzanthracene, chrysene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene, dibenz(a,h)anthracene, benzo(g,h,i)perylene, and indeno(1,2,3-c,d)pyrene. Analysis of stomach contents of bottom-feeding fish might be used to determine PAH levels in areas where sediment samples are difficult to obtain. (Rochester-IVI)
W86-00694

PCBS IN STRIPED BASS COLLECTED FROM THE HUDSON RIVER, NEW YORK, DURING FALL, 1981,
State Univ. of New York at Albany. Dept. of Atmospheric Science.
For primary bibliographic entry see Field 5C.
W86-00695

TOXICITY AND ACCUMULATION OF COPPER AND CADMIUM IN THE ALGA SCENEDESMUS OBLIQUUS LH,
Vysoka Skola Zemedelska v Praze, Ceske Budejovice (Czechoslovakia). Faculty of Agricultural Economics and Management.
For primary bibliographic entry see Field 5C.
W86-00697

SIMULATED SOLUTE MOVEMENT IN WASTEWATER-PONDED SOIL,
Florida Univ., Gainesville. Dept. of Plant Pathology.
For primary bibliographic entry see Field 5D.
W86-00699

SOLUTE DISPERSION DURING AXISYMMETRIC THREE-DIMENSIONAL UNSATURATED WATER FLOW,
Department of Scientific and Industrial Research, Palmerston North (New Zealand). Div. of Plant Physiology.
For primary bibliographic entry see Field 2G.
W86-00700

SOLUTE DISCHARGE DURING STEADY WATER DRAINAGE FROM A SAND TANK,
Florida Univ., Gainesville. Dept. of Plant Pathology.
For primary bibliographic entry see Field 2G.
W86-00701

MONTE-CARLO SIMULATION OF NONINTERACTING SOLUTE TRANSPORT IN A SPATIALLY HETEROGENEOUS SOIL,
Texas A and M Univ., College Station.
For primary bibliographic entry see Field 2G.
W86-00702

MOBILITY OF ZINC, CADMIUM, COPPER, LEAD, IRON AND ARSENIC IN GROUND WATER AS A FUNCTION OF REDOX POTENTIAL AND PH,
Essen Univ. (Gesamthochschule) (Germany, F.R.). Fachbereich 9 - Geologie.
R. Hermann, and P. Neumann-Mahlkau.
Science of the Total Environment, Vol. 43, No. 1-2, p 1-12, May, 1985. 11 Fig, 23 Ref.

Descriptors: *Groundwater pollution, *Zinc, *Cadmium, *Copper, *Lead, *Iron, *Arsenic, *Redox potential, *Hydrogen ion concentration, Path of pollutants, Solubility, Soil contamination, Heisinger Aue, Germany (Federal Republic).

In most industrialized regions, surface water and soil are contaminated with Cd, As, Pb, and Zn as a result of air and water pollution over many years. When the groundwater table moves up into the zone of contaminated soil, the redox potential and ph, as well as the mobility of the toxic elements are changed and can pose a threat if the contaminated area is a source of drinking water. The analysis of ground water taken from different soil horizons in the Heisinger Aue area (Essen, Federal Republic of Germany) confirmed the theoretically calculated influence of the redox potential and pH on the mobility of these elements. Zn, Cd, and Cu only show a pronounced solubility in an oxidizing environment. The degree of solubility in such environments depends largely on the pH. In a reducing environment, the solubility of Zn, Cd, and Cu can be decreased because of sulfide formation. Within the ranges of Eh and pH observed the mobility of Pb seems to be relatively low. Arsenic, like Fe, was found to be much more mobile under reducing than under oxidizing conditions. Groundwater of low Eh may be contaminated by As contained in polluted soils, sediments, or wastes. (Moore-IVI)
W86-00706

MERCURY DISTRIBUTION IN A POLLUTED MARINE AREA. CONCENTRATIONS OF METHYL MERCURY IN SEDIMENTS AND SOME MARINE ORGANISMS,
Institut Rudjer Boskovic, Zagreb (Yugoslavia). Center for Marine Research.
For primary bibliographic entry see Field 5A.
W86-00707

CHEMICAL COMPOSITION OF HIGHWAY DRAINAGE WATERS; I. MAJOR IONS AND SELECTED TRACE METALS,
Lancaster Univ., Bailrigg (England). Dept. of Environmental Sciences.
R. M. Harrison, and S. J. Wilson.
Science of the Total Environment, Vol. 43, No. 1-2, p 63-77, May, 1985. 2 Fig, 3 Tab, 27 Ref.

Descriptors: *Drainage water, *Chemical composition, *Trace metals, *Highways, Dissolved solids, Particulate matter, Potassium, Magnesium, Sodium, Calcium, Chloride, Sulfates, Lead, Iron, Manganese, Copper, Cadmium, Storm runoff.

Measurements of volumetric discharge and concentrations of dissolved (< 0.45 micro-m) and particulate (> 0.45 micro-m) major ion and trace metal components or road drainage water have been made during ten storm events at a motorway site in northwest England. With the exception of K(+) and Mg(2+), which were often significantly associated with the particulate (> 0.45 micro-m) fraction, the major ion constituents (Na(+), Ca(2+), Cl(-) and SO4(2-) were predominantly in the dissolved (< 0.45 micro-m) fraction. Of the trace metals, Pb and Fe were largely particle-associated, Mn was predominantly dissolved, and Cu and Cd exhibited intermediate behavior. A 'first flush' effect is seen for the dissolved (< 0.45 micro-m) components, but the particle-associated elements show a much more complex temporal variation related to storm intensity and the flushing of large-grained sediment through the drainage system. (Author's abstract)
W86-00708

CHEMICAL COMPOSITION OF HIGHWAY DRAINAGE WATERS; II. CHEMICAL ASSOCIATIONS OF METALS IN THE SUSPENDED SEDIMENT,
Lancaster Univ., Bailrigg (England). Dept. of Environmental Sciences.
R. M. Harrison, and S. J. Wilson.
Science of the Total Environment, Vol. 43, No. 1-2, p 79-87, May, 1985. 3 Fig, 3 Tab, 9 Ref.

Descriptors: *Highways, *Drainage waters, *Metals, *Suspended sediments, Lead, copper, Iron, Manganese, Runoff, Particle size.

Chemical associations of metals in the suspended sediment fraction of highway drainage waters have been investigated. Significant positive correlations between concentrations of pairs of metals in the suspended particles (> 0.45 micro-m) were found, the most highly correlated being Pb and Cu, Fe and Cu, and Fe and Mn. The concentrations of metals in the suspended sediment decrease with increasing concentrations of suspended solids in the runoff water indicative of lower metal concentrations associated with larger grained sediments suspended at high discharge rates. Sequential extraction of suspended solids separated by centrifugation showed similar chemical associations of metals to those in road surface dusts, with a generally higher overall metal concentration in the suspended solids. This is interpreted as indicating that the suspended sediment is derived from road surface dusts modified by preferential suspension of the finer grain sizes. (Author's abstract)
W86-00709

CHEMICAL COMPOSITION OF HIGHWAY DRAINAGE WATERS; III. RUNOFF WATER METAL SPECIATION CHARACTERISTICS,
Lancaster Univ., Bailrigg (England). Dept. of Environmental Sciences.
R. M. Harrison, and S. J. Wilson.
Science of the Total Environment, Vol. 43, No. 1-2, p 89-102, May, 1985. 1 Fig, 7 Tab, 12 Ref.

Descriptors: *Highways, *Drainage waters, *Runoff, *Metals, *Chemical speciation, Cadmium, Copper, Lead, Manganese, Iron, Storm runoff, Hydrogen ion concentration, Flow.

As part of an investigation of the removal of road surface contaminants in runoff water, samples of road drainage water have been examined by a comprehensive speciation scheme involving size discrimination by filtration through Nuclepore filters, anodic stripping voltammetry both with and without UV irradiation, and equilibration with Chelax resin, with a view to understanding the chemical associations of Cd, Cu, Pb, Mn and Fe in the waters. Samples were taken to represent different stages of a storm event and changes in speciation are seen to reflect changes in the flow regime and pH of the drainage water system. Upon leaving the highway, the waters enter a small receiving stream in which the speciation characteristics of the water downstream of the outfall were found to be dominated by the input drainage waters. (Author's abstract)
W86-00710

EULERIAN MODEL FOR SCAVENGING OF POLLUTANTS BY RAINDROPS,
General Motors Research Labs., Warren, MI. Environmental Science Dept.
S. Kumar.
Atmospheric Environment, Vol. 19, No. 5, p 769-778, 1985. 6 Fig, 4 Tab, 24 Ref.

Descriptors: *Rain, *Scavenging, *Air pollution, *Eulerian models, Water pollution sources, Simulation, Adsorption, Differential equations, Hydrogen ion concentration, Ammonia, Hydrogen peroxide, Sulfur dioxide, Formaldehyde, Nitric acid, Solubility.

An Eulerian model for simulating the coupled processes of gas-phase depletion and aqueous-phase accumulation of the pollutant species during a rain event has been formulated. The model is capable of taking into account any realistic vertical profile of pollutant species concentrations and time-dependent initial aqueous-phase concentrations at the cloud base. The model considers the processes of single species absorption and dissociation in the aqueous phase. The coupled partial differential equations constituting the model are discretized into a set of ordinary differential equations by using the Galerkin method with chapeau functions as the basis functions. These equations are solved to obtain the pollutant concentrations of the gas phase and raindrops as well as the pH of raindrops as a function of time and distance below cloud-base. Simulations are performed for scavenging of gaseous HNO3, H2O2, SO2, formaldehyde and NH3. For the case of highly soluble HNO3 and H2O2, raindrops are far from equilibrium with gas phase and their capacity for absorption of these gases is undiminished even as they reach ground level. The gas-phase concentrations for these species decrease exponentially with time and the washout is determined primarily by the rain intensity and mass-transfer coefficient of the gaseous species to the raindrops. The pollutant species concentrations in raindrops are an almost linear function of the distance below the cloud base. For the simulation conditions considered in this study, the half-life periods of these gases for removal from the atmosphere range from 15 to 40 min. For SO2 and formaldehyde, the aqueous-phase concentrations approach equilibrium as the drops fall to ground level and the gas-phase concentrations show large gradients in the vertical. Half-life periods for SO2 range from 1.3 to 13 h depending on the initial raindrop pH and rain intensity. For formaldehyde, the half-life ranges from 19 to 63 min. Solubility of NH3 is a strong function of the raindrop pH. As NH3 is absorbed, the raindrop pH increases and NH3 solubility decreases. For pre-acidified drops (pH = 4.6), ammonia solubility is very high and the drops are far from equilibrium with the gas phase throughout the falling period. The half-life for ammonia ranges from 11 min to over 3 h in these simulations. (Author's abstracts)
W86-00718

WET AND DRY DEPOSITION MONITORING IN SOUTHEASTERN MICHIGAN,
General Motors Research Labs., Warren, MI. Environmental Science Dept.
For primary bibliographic entry see Field 5A.
W86-00719

NUTRIENT FLUXES IN EUTROPHIC COASTAL LOUISIANA FRESHWATER LAKE,
Louisiana State Univ., Baton Rouge. Center for Wetland Resources.
For primary bibliographic entry see Field 2H.
W86-00724

HEAVY METAL CONCENTRATIONS IN MUNICIPAL WASTEWATER TREATMENT PLANT SLUDGE,
O'Brien and Gere Engineers, Inc., Syracuse, NY.
S. J. Spiegel, J. K. Farmer, and S. R. Garver.
Bulletin of Environmental and Toxicology, Vol. 35, No. 1, p 38-43, July, 1985. 3 Tab, 12 Ref.

Descriptors: *Municipal wastewater, *Wastewater treatment, *Sludge, *Heavy metals, *New York, Fate of pollutants, Metals, Primary wastewater treatment, Secondary wastewater treatment, Industrial wastes, Industrial wastewater, Water pollution sources.

Analysis of metals in final sludges from 11 municipal wastewater treatment plants in New York State revealed wide variations among plants for a given metal. Final sludges from Schenectedy, Geneva, Dunkirk, Poughkeepsie, Herkimer County, Jamestown, Peekskill, and Yonkers had received secondary treatment; sludge samples from Mamaroneck, Port Chester, and Blind Brook had received only primary treatment. Concentrations of priority pollutant metals at the plants in which secondary treatment was employed varied widely (all in mg/kg), for example: Ag, 0.62-54; As, 0.03-4.6; Cd, 0.15-14.6; Cr (total), 1.6-3,628; Hg, 0.07-9.81; and Pb, 6.1-472. Wide variations were also seen in values for sludges receiving only primary treatment. Within the two groups, Yonkers and Port Chester, respectively, had generally much lower levels of most heavy metals than the other plants,

but the variability in analyses among the remaining plants was so great no categorization based on heavy metals was possible. The differences among sludges in terms of heavy metal content seem to be due to differences in local industrial contributions to the wastewater and differences in domestic contributions of specific heavy metals. (Rochester-IVI)
W86-00726

FACTORS INFLUENCING THE HIGH CONTENT OF BROMINATED TRIHALOMETHANES IN BARCELONA'S WATER SUPPLY (SPAIN),
Sociedad General de Aguas de Barcelona (Spain).
F. Ventura, and J. Rivera.
Bulletin of Environmental Contamination and Toxicology, Vol. 35, No. 1, p 73-81, July, 1985. 3 Fig, 5 Tab, 12 Ref.

Descriptors: *Brominated trihalomethanes, *Barcelona, *Spain, *Water supply, *Llobregat River, Water quality, Chlorine, Water treatment, Fate of pollutants, Water pollution sources.

Bromide from salt mines upstream, chlorine added during treatment, and total organic carbon all appear to play roles in trihalomethane (THM) formation in the water supply of Barcelona, Spain. Water samples from the Llobregat River, a stream heavily polluted from textile, galvanic, coal, salt works, and pulp mill industries, and farms and residences, were subjected to a series of tests to determine the source of the THMs. Maximum THM formation occurred about 20 hr after addition of Cl2 to the raw water, which is in agreement with results with finished water. As Cl2 concentration was increased from 5-50 mg/l, there was a shift towards more chlorinated compounds at the expense of more brominated ones. A change of as little as 1 mg/l Cl2 in these waters of high ammonia and bromide content increased the THM content by more than 30% in some cases. It was also established that formation of chloroamines proceeds more rapidly than synthesis of hypobromite, and therefore bromoamines are probably produced at higher rates than BrTHMs which accounts for the low levels of BrTHMs measured. After 6 wk, the efficiency of granular activated carbon for removal of THMs dropped to below 20%, with some compounds, such as CHCl3, being retained at less than 20% efficiency within 3-4 wk. This appeared to be due to the organic pollution load of this water. THM levels in Barcelona's drinking water exhibit strong variations associated with the irregular releases at the salt mines, other industrial activity along the river, and the extreme changes in river discharge. Inconsistent results were obtained in an attempt to correlate THM content with total organic carbon. High levels of BrTHMs should be reduced by installation of a pipeline leading salt mine wastes directly to the sea. (Rochester-IVI)
W86-00727

STORM WATER RUNOFF FROM INDUSTRIAL SITES,
Baxter and Woodman, Inc., Crystal Lake, IL.
D. R. Gavle.
Pollution Engineering, Vol. 16, No. 12, p 34-37, December, 1984. 3 Fig.

Descriptors: *Storm runoff, *Runoff, *Water pollution sources, *Industrial plants, Industrial wastes, Rainfall-runoff relationships, Urban runoff.

If contaminated runoff is leaving an industrial site, an investigation should be instituted that consists of the following steps: (1) analysis of storm water runoff samples to determine the types and quantities of pollutants present, (2) determination of the peak runoff rates and runoff volumes for the site, (3) determination of required reduction in pollutants (depending on whether site is a point or nonpoint source), (4) evaluation of different management techniques, and (5) development of an effective mangement strategy. A typical equation for determining peak runoff rates is: Q = C x I x A, where Q = peak runoff rate in cu ft/sec of water, C = a dimensionless runoff coefficient based on the surface characteristics of the site, I = rainfall intensity in inches/hr, and A = the size of the drainage area in acres. Values of runoff rates increase according to rainstorm frequency (100 yr > annual), and according to type of development (downtown business > industrial > residential). For example, the runoff expected from a residential area with a rainstorm that would be expected to occur every 2 yr (0.51 cu ft/sec/acre) is much less than the 2 yr-occurrence figure for a downtown business area (1.23 cu ft/sec/acre). Management techniques available for control of runoff from industrial sites include segregation of polluted runoff from nonpolluted runoff, spill containment, and, if necessary, treatment to remove pollutants before discharge. (Rochester-IVI)
W86-00766

TRACE-METAL CONCENTRATIONS IN SEDIMENTS FROM TWO CLOSED-BASIN LAKES, ANTARCTICA,
New Hampshire Univ., Durham. Dept. of Earth Sciences.
For primary bibliographic entry see Field 2H.
W86-00770

MATHEMATICAL MODEL FOR ANALYSIS OF SEDIMENT CORE DATA: IMPLICATIONS FOR ENRICHMENT FACTOR CALCULATIONS AND TRACE-METAL TRANSPORT MECHANISMS,
Freshwater Biological Association, Ambleside (England).
J. Hilton, W. Davison, and U. Ochsenbein.
Chemical Geology, Vol. 48, No. 1/4, p 281-291, March, 1985. 2 Fig, 3 Tab, 21 Ref.

Descriptors: *Mathematical models, *Trace metals, *Enrichment factors, *Sediments, Fate of pollutants, Aluminum, Potassium, Magnesium, Zinc, Cadmium, Iron, Nickel, Copper, Lead, Clay, Minerals, Lake sediments.

The concentration of trace metal within a sediment core has been modelled by considering three components, the background concentration, C sub b, that due to accelerated erosion, C sub a, and an anthropogenic pollution term, C sub p. Major cations associated with clay minerals such as Al, K and Mg do not have a pollution component. Iterative regression of the trace-metal concentration against one of these elements permits the isolation of C sub p. The model was applied to a comprehensive data set for a sediment core collected from a seasonally anoxic lake. Three groups of trace metals were identified. Type A (Zn and Cd) did not have a component due to accelerated erosion, C sub a. They are thought to have passed through a solution phase before being recruited to the sediment. Type-B metals (Fe, Ni, Cu and Pb) correlated well with the clay mineral elements and were probably transported to the sediment as particles. Mn, the type-C metal, was inversely related to the clay mineral cations, reflecting its labile redox chemistry. Various methods of calculating metal enrichment were compared with the new enrichment after regression analysis procedure (ERA method). Although simple concentration ratios are appropriate for type-A metals neither this procedure nor enrichment factors can adequately assess enrichment of type-B metals. (Author's abstract)
W86-00772

INFLUENCE OF PH ON THE BINDING CAPACITY AND CONDITIONAL STABILITY CONSTANTS OF ALUMINUM AND NATURALLY-OCCURRING ORGANIC MATTER,
Savannah River Ecology Lab., Aiken, SC.
For primary bibliographic entry see Field 2K.
W86-00773

STATUS OF NONPOINT SOURCE POLLUTION: ITS NATURE, EXTENT AND CONTROL,
Battelle Columbus Div., OH.
B. W. Vigon.
Water Resources Bulletin, Vol. 21, No. 2, p 179-184, April, 1985. 2 Fig, 1 Tab, 4 Ref.

Descriptors: *Nonpoint pollution sources, *Water pollution control, Water pollution sources, Water quality, Stream pollution.

Nonpoint source pollution remains as the primary reason for the designation of many of the Nation's streams as 'water quality limited.' This means that even with the application of technology-based effluent limitations on point sources, ambient water quality standards will not be met. This paper explores several of the reasons why nonpoint sources are so difficult to come to grips with. These reasons include: (1) the inability to expand the definition of nonpoint sources to encompass nonengineering attributes, (2) the relatively primitive state of characterizing nonpoint sources, (3) the lack of prior success in conducting programs to study and alleviate nonpoint problems, and (4) and uncertain approach to providing incentives for control practices. (Author's abstract)
W86-00779

POLLUTANT RUNOFF MODELS: SELECTION AND USE IN DECISION MAKING,
Duke Univ., Durham, NC. School of Forestry and Environmental Studies.
K. H. Reckhow, J. B. Butcher, and C. M. Marin.
Water Resources Bulletin, Vol. 21, No. 2, p 185-195, April, 1985. 1 Fig, 47 Ref.

Descriptors: *Runoff, *Model studies, *Path of pollutants, *Decision making, Water quality management, Planning, Costs, Simulation, Phosphorus, Eutrophication.

Models for pollutant runoff can be useful in water quality management planning if appropriately structured for the problem at hand. Accordingly, a 'top-down' approach is proposed for the examination of extant pollutant runoff models. The approach consists of the identification of objectives and attributes that reflect the needs of planners and decision makers when these models are used for water quality management planning. Ideally, the attributes should concern the effect of model information on improved decision making and the cost of model application. Practical difficulties with the first attribute necessitates substitution of surrogate attributes reflecting model appropriateness, resolution, and uncertainty. Common pollutant runoff models, in particular export coefficients and hydrology-driven simulation models, are found to have serious weaknesses on some of the attributes scales. The 'top-down' approach leads to a set of desirable pollutant runoff model attributes; alternate modeling techniques are thus examined in order to identify promising future directions for model development. The focus of this examination is phosphorus, due to its importance in the eutrophication of surface waters. Models for both sediment-attached and dissolved phosphorus are considered. Among the conclusions is the belief that the partial contributing area concept can yield an effective yet simple simulation despite the variable and complex nature of runoff. (Author's abstract)
W86-00780

URBAN RUNOFF: POLLUTION SOURCES, CONTROL, AND TREATMENT,
Environmental Protection Agency, Edison, NJ. Storm and Combined Sewer Technology Branch.
For primary bibliographic entry see Field 5G.
W86-00781

CHEMICAL COMPONENTS IN THE PRECIPITATION AT KOMORO AND TSUKUBA, JAPAN IN 1983,
Meteorological Research Inst., Tokyo (Japan).
Y. Dokiya, Y. Katsuragi, and S. Kobayashi.
Journal of Environmental Science and Health, Vol. A20, No. 3, p 269-291, April, 1985. 7 Fig, 5 Tab, 8 Ref.

Descriptors: *Chemistry of precipitation, *Precipitation, *Honshu Island, *Acid rain, *Japan, Hydrogen ion concentration, Chlorides, Nitrates, Sulfates, Sodium, Potassium, Calcium, Magnesium, Water pollution sources, Air pollution, Spatial distribution.

The net deposition of major chemical components by precipitation in the Honshu Island of Japan was

investigated during each precipitation event for one year in 1983 at two sites: Komoro City, an inland city and Tsukuba Science City, which was located on the Pacific side. Both sampling sites are at a similar latitude and are rural areas of similar population. The concentrations of hydrogen ion, chloride, nitrate, sulfate, sodium, potassium, calcium and magnesium ions were determined in samples from each rain and summarized on a monthly basis. The concentrations of hydrogen, sulfate and nitrate ions were several times higher at Tsukuba than at Komoro. The average pH at Tsukuba and Komoro were 4.54 and 5.34, respectively; the former was apparently influenced by the polluted air from the industrial area including Tokyo and the latter was comparatively free from the influence. The identification of sources for each chemical component is discussed. (Author's abstract)
W86-00810

DISTRIBUTION AND PERSISTENCE OF AMINOCARB IN STREAM WATER, SEDIMENT AND FISH AFTER APPLICATION OF THREE MATACIL FORMULATIONS,
Forest Pest Management Inst., Sault Sainte Marie (Ontario).
K. M. S. Sundaram, and S. Szeto.
Journal of Environmental Science and Health, Vol. B20, No. 2, p 187-200, April, 1985. 2 Fig, 3 Tab, 5 Ref.

Descriptors: *Aminocarb, *Insecticides, *Fate of pollutants, *Path of pollutants, *Streams, *Fish, *Sediment, Water pollution effects, Trout, Pesticides.

Three aminocarb formulations, water-based Matacil 180F, oil-based Matacil 180F and oil-based Matacil 180D, were applied separately to the surface of a stream at 2.40 g a.i./min for 5 minutes. The highest aminocarb concentration in the top 1 cm of water (5000 ppb) was found 5 min after application of oil-based 180F. The next highest concentration was 1862 ppb found in the top 1 cm layer of water 3 min after application of oil-based 180D, followed by 1306 ppb found 5 min after application of water-based 180F. Residue accumulations were first observed in sediment at 3 min and in fish tissues 0.5 h after application. The levels of accumulation were in the order of water-based 180F > oil-based 180F > oil-based 180-D. After the application of water-based 180F, the highest concentrations were 20.2 ppb in sediment after 5 min and 127 ppb in fish tissues after 3 h. Residues disappeared rapidly from all three matrices and could not be detected after a period of 3-25 h. (Author's abstract)
W86-00811

SORPTIVE CAPACITY OF AN AQUATIC MACROPHYTE FOR THE PESTICIDE AMINOCARB,
Ottawa Univ. (Ontario). Dept. of Biology.
For primary bibliographic entry see Field 5A.
W86-00812

DISTRIBUTION OF GAMMA EXPOSURE RATES IN A REACTOR EFFLUENT STREAM FLOOD PLAIN SYSTEM,
Savannah River Ecology Lab., Aiken, SC.
J. B. Gladden, K. L. Brown, M. H. Smith, and A. Towns.
Health Physics, Vol. 48, No. 1, p 49-59, January, 1985. 3 Fig, 3 Tab, 26 Ref. U.S. DOE contract DE-AC09-76SR00819.

Descriptors: *Gamma radiation, *Cesium radioisotopes, *Fate of pollutants, Path of pollutants, Radiation, Radioisotopes, Sediments.

Ground-level gamma dosimetry surveys were conducted along the length of a radiocesium-contaminated reactor effluent stream flood plain system to determine the extent and patterns of isotope distribution over a decade after reactor releases were stopped. The maximum mean exposure rates were found at upstream locations near the source of the contamination and in a downstream sedimentary delta. Gamma exposure rates were not uniformly distributed and high exposure rates were generally restricted to small areas of the flood plain. There was little similarity in either the spatial distribution or magnitudes of maximum gamma exposure rates across flood plains along the stream. Frequency distributions of the measured exposure rates tended to be highly skewed and most closely approximated the log-normal distribution in most areas along the stream. However, the complex and changing patterns of dose distributions strongly affected the ability to predict the probability of encountering unusually high exposure rates. Complex statistical and distributional models are required to provide precise descriptions of the dosimetry environment in such complex ecosystems and different models could be required on a site-by-site basis. (Author's abstract)
W86-00821

RADIOCESIUM LEVELS IN IRISH SEA FISH AND THE RESULTING DOSE TO THE POPULATION OF THE IRISH REPUBLIC,
Trinity Coll., Dublin (Ireland). Dept. of Pure and Applied Physics.
I. R. McAulay, and C. Doyle.
Health Physics, Vol. 48, No. 3, p 333-337, March, 1985. 2 Fig, 1 Tab, 4 Ref. Commission of European Communities contract B10/B/388/80/EIR(H).

Descriptors: *Cesium radioisotopes, *Irish Sea, *Fish, *Public health, *Radiation, *Sellafield, Path of pollutants, Whiting, Cod, Plaice, Prawn, Herring.

Radioactive wastes in have been released from the nuclear fuel reprocessing plant at Sellafield (formerly 'Windscale') for longer than two decades under license from British authorities. Most monitoring has been conducted in the Eastern Irish Sea close to the discharge point with the result that less is known about radiocesium levels off the Irish coast. Whiting, cod, plaice, prawn, and herring samples were obtained from the commercial fishing grounds off the East Irish Coast and assayed for Cs-137 and Cs-134 contamination; average activities of 68 and 3 Bq/kg (wet, fillets) of Cs-137 and Cs-134, respectively, were determined. The ratio of Cs-137 to Cs-134 present in the samples was about 23; during the same period, the ratio in fish caught near Sellafield was about 15. The difference in the ratios is explained by the time taken for transport of the radiocesium from the East Irish Sea to the West Irish Sea and the average residence time in the West Irish Sea; this time lag can be estimated from these ratios to be about 1.4 yr. The radiation dose incurred by a person eating fish will depend on the average activity of the fish and the quantity eaten. The average activity of different species will in general be different. The assumed dose rate due to penetrating environmental radiation for the collective population is 3400 man-Sv/y. The estimated population dose to the Irish public due to fish consumption is approximately 2 man-Sv/y - only 0.06% of the environmental dose. Critical groups may exist, such as fishing communities along the east coast, for whom doses may be higher. The possible dose to a member of the critical group is 1.4% of the limit recommended by the International Commission on Radiological Protection. (Collier-IVI)
W86-00822

RADIOLOGICAL IMPACT OF MINING IN A TH-RICH NORWEGIAN AREA,
Statens Inst. for Straalehygiene, Oslo (Norway).
E. Stranden.
Health Physics, Vol. 48, No. 4, p 415-420, April, 1985. 6 Tab, 12 Ref.

Descriptors: *Radioisotopes, *Mining, *Thorium, *Norway, Drinking water, Water pollution sources, Public health, Radon, Radium, Niobium, Radiation.

The radiological impact of former mining activities in the Fen area in southern Norway has been assessed. The area is known to have enhanced concentrations of Th. A recent epidemiological study suggested a significant increment of lung cancer among the former miners, and the doses to the miners have been assessed. The main contributor to the effective dose equivalent in one of the mines was inhaled Rn-220 progeny. Water in drilled wells and in nearby lakes was analyzed for Rn-220 and Ra. Uranium and Th analyses were performed on mine and lake water. The mining activity does not seem to have contaminated drinking water significantly. The tailings from Nb production has enriched Ra and Th concentrations. The tailings and the possible use of waste rock from the mining are probably the most important environmental results of the mining activities. (Author's abstract)
W86-00823

MICROBIOLOGICAL QUALITY OF RECREATIONAL WATERS IN THE PACIFIC NORTHWEST,
Environmental Protection Agency, Seattle, WA. Region X.
G. J. Vasconcelos, and N. C. Anthony.
Journal of Water Pollution Control Federation, Vol. 57, No. 5, p 366-377, May, 1985. 1 Fig, 5 Tab, 34 Ref.

Descriptors: *Water quality, *Recreational waters, *Bacteria, Washington, Oregon, Idaho, Marine environment, Water pollution sources, Coliforms, Bioindicators.

A 5-yr study of total coliforms (TC), fecal coliforms (FC), Escherichia coli, fecal streptococci (FS), enterococci, and water quality indicators at eight freshwater and two marine beaches in the Pacific Northwest (USA) revealed large variations in bacterial count and water quality. Two grab samples, one for bacteria and one for water analysis, were obtained at each of the sites, which were in or near the cities of Seattle, Spokane, and Clarkston, Washington, Eugene, Oregon, and Lewiston, Idaho. Most locations were city, county, or state parks with records of heavy bather use for at least a 4-mo summer season, and more than half of the sites were located downstream or close to wastewater treatment plant outfalls. Beaches with the highest TC and 20 C plate count (PC) organism levels were both surrounded by large residential communities subject to urban runoff. The marine beaches at Alki and Gold Gardens were relatively low in TC and PC microorganisms. In most instances FS densities determined by the KF procedure were higher than enterococci recovered by the mE procedure. Beaches with high mean values of enterococci did not always have correspondingly high mean FC values and, conversely, beaches with high FC averages did not always have a high enterococci average. Water quality criteria for Northwest recreational waters should include guidelines based on both microbial densities and an assessment of human health risks associated with the potential for disease transmission. Marine recreational waters may share the same degree of microbiological pollution as freshwater, but the potential for contact illness among swimmers is less because of lower seasonal water temperature. With the exception of water temperatures, all physical and chemical measurements made during this study were similar, regardless of location or season. The lack of variability in these measurements precludes their use in future monitoring studies. (Rochester-IVI)
W86-00840

BACTERIAL ADSORPTION AND SUSPENDED PARTICLES IN URBAN STORMWATER,
California State Univ., Northridge.
J. E. Schillinger, and J. J. Gannon.
Journal of the Water Pollution Control Federation, Vol. 57, No. 5, p 384-389, May. 1985. 4 Fig, 3 Tab, 28 Ref.

Descriptors: *Bacterial, *Adsorption, *Suspended particulates, *Urban runoff, Storm wastewater, Coliforms, Klebsiella, Pseudomonas, Escherichia.

Fecal coliforms collected from a stormwater drain showed significantly lower mean retention on screens (15.9%) and less sedimentation (16.8%) than did the opportunistic pathogen Klebsiella (25.7% and 33.0%, respectively) or the large group measured as Gram-negative bacteria (37.3% and 46.7%, respectively). In every case, however,

more than 50% of the stormwater bacteria were not settled or filtered (< 5 micrometer), which showed that sufficient numbers of bacteria may remain suspended in water under similar treatment conditions to pose a health hazard. These stormwater results suggest that adsorption (retention and settling) was of sufficient magnitude (average 16-47%) to warrant study of bacterial attachment and sedimentation when modeling bacterial disappearance in natural waters or treatment processes. Samples used in this study were all collected at the time of peak flow during storm events at Allen Drain, near Ann Arbor, Michigan. Most bacteria that were retained on screens were associated with particles retained on 52 micrometer or 30 micrometer screens. Nutrient agar-grown pure cultures were much less effectively adsorbed on added sediment than were broth-grown cells. The presence of fimbriae (pili) on broth-grown Escherichia coli, as shown by electron microscopy, and polysaccharide slime layers produced by Klebsiella and Pseudomonas may have affected bacterial attachment, in the first case positively, and in the second case negatively. (Rochester-IVI)
W86-00842

FACTORS AFFECTING STREAM TRANSPORT OF COMBINED SEWER OVERFLOW SEDIMENTS,
Brigham Young Univ., Provo, UT.
S. L. Klemetson.
Journal of the Water Pollution Control Federation, Vol. 57, No. 5, p 390-397, May, 1985. 5 Fig, 15 Tab, 20 Ref.

Descriptors: *Combined sewer overflows, *Sediment transport, *Sedimentation, Wastewater, Urban runoff, Particle size, Specific gravity, Viscosity, Density.

Wastewater and urban runoff were characterized individually, and these characteristics were extrapolated to obtain combined sewer overflow (CSO) characteristics of importance to the physical transport of CSO solids. The contribution of wastewater to the total flow may be negligible in many cases, although its effect on time-dependent changes in the CSOs may be important. Urban surface runoff makes up the majority of CSO in most cases. The characteristics of urban-surface solids may, as a first approximation, be considered similar to those of street-surface solids. In modeling the transport of CSO solids, two basic classes for processes must be considered: (1) transport depends on the quiescent settling characteristics of the solids and (2) any time-dependent changes in the settling characteristics, mass rate, or other transport variables must be included in the analysis. The variables that affect quiescent settling of discrete, non-reactive particles are particle size, specific gravity and shape, and fluid density and viscosity. These data are available from a variety of sources, and from them it is possible to generate data that may be at least representative of selected CSO solids characteristics. (Rochester-IVI)
W86-00843

MODIFICATION OF A METAL ADSORPTION MODEL TO DESCRIBE THE EFFECT OF PH,
Texas A and M Univ., College Station. Dept. of Civil Engineering.
J. L. Martin, B. Batchelor, and S. C. Chapra.
Journal of the Water Pollution Control Federation, Vol. 57, No. 5, p 425-427, May, 1985. 2 Fig, 10 Ref.

Descriptors: *Metals, *Adsorption, *Hydrogen ion concentration, *Mathematical models, Fate of pollutants, Model studies, Sediments, Solution equilibrium.

The Nelson metal adsorption model was modified to describe the effect of pH on adsorption apart from the value of the equilibrium constant. This approach allows easy estimates of pH effects for a wide pH range using concentration techniques for solving simultaneous chemical equilibriums. The modification of the model also allows it to be more easily extrapolated to describe adsorption in systems with different solution chemistry. The Nelson model can predict speciation at arbitrary pH values only by interpretation or extrapolation from the pH values used to calculate the conditional adsorption constant (K sub A). The modified model interprets adsorption as a competition between metal ions and protons for surface sites. This surface complex modeling approach gave reasonably good fit between measured and predicted metal adsorption onto Meuse River sediments. Alternatively, the Langmuir isotherm used in the modified model can be expressed in mass concentration units to allow calibration against experimentally determined adsorption data. This alternative formulation includes pH effects. The present modification of Nelson's model can be incorporated into equations for determining the distribution of metals among species and surfaces. This approach has been used to predict diel variations of zinc in a reservoir where predicted mixing and ligand distributions were used to analyze variability in zinc distributions. The modification also provides for the use of computer equilibrium programs to describe adsorption equilibrium while describing solution equilibrium. (Rochester-IVI)
W86-00847

VIRAL POLLUTION OF THE MARINE ENVIRONMENT,
Minnesota Univ., St. Paul. Coll. of Veterinary Medicine.
S. M. Goyal.
CRC Critical Reviews in Environmental Control, Vol. 14, No. 1, p 1-32. 8 Fig, 13 Tab, 148 Ref. NOAA grant NA80AA-D00049.

Descriptors: *Public health, *Sludge disposal, *Ocean dumping, *Viruses, *New York Bight, Sewage outfalls, Fate of pollutants, Water pollution effects, Shellfish, Path of pollutants, Water quality standards.

Available data on the occurrence, transport, and fate of enteric viruses in the marine environment are summarized, and the viral hazards to human health associated with the disposal of sewage effluents and sludges in coastal and open ocean waters are assessed. Human enteric viruses in domestic sewage, fate and transport of viruses in the marine environment, including occurrence and survival in coastal waters, association with solids, and accumulation in shellfish, and methods for detection of viruses in water, sediment, and shellfish are described. Viruses in coastal waters have been associated with canal communities, which are very popular along the coasts of Florida, Mississippi, California, Louisiana, and Texas, with submarine offshore sewage outfalls, with disposal of dredged material from harbors, channels, and other navigable waterways, and as the direct result of sludge dumping. Viruses have been found in sediments both inside and outside the shellfish closure area in the New York Bight and at the Philadelphia disposal site, including some isolations made at the latter site 17 mo after cessation of sludge dumping. All current standards for viruses in recreational and potable water are arbitrary and reflect limitations of detection methodology for enteric viruses in water rather than disease risk. Present epidemiological methods are not adequate to gain a complete understanding of the true extent of transmission of viral disease by marine waters. (Rochester-IVI)
W86-00851

HYDROUS FE AND MN OXIDES - SCAVENGERS OF HEAVY METALS IN THE AQUATIC ENVIRONMENT,
Jawaharlal Nehru Univ., New Delhi (India). School of Environmental Sciences.
S. K. Singh, and V. Subramanian.
CRC Critical Reviews in Environmental Control, Vol. 14, No. 1, p 33-90. 21 Fig, 33 Tab, 221 Ref.

Descriptors: *Iron oxides, *Magnesium oxides, *Heavy metals, *Coatings, *Detritus, Metals, Hydroxides, Fate of pollutants, Water pollution control, Adsorption.

The role of Fe(OH)3 and MnO2 coatings on detrital particles in the control of heavy metals in rivers and estuaries is discussed. Heavy metals in the environment, chemistry of hydrous metal oxides, heavy metals in river water, water-sediment interactions, hydroxide coatings and concretions, effects of particle size on sediment composition, and fixation of heavy metals by hydrous Fe/Mn oxides are reviewed. Mechanisms of trace metal fixation by hydrous Fe/Mn oxides are discussed, including the roles of precipitate age and organic material in uptake of heavy metals by hydrous Fe/Mn oxides. Remobilization of heavy metals, application of hydrous oxides to pollution control, heavy metals in sewage sludges, and the role of Fe/Mn oxide-mediated absorption of heavy metals in natural systems are also reviewed. Several aspects of the role of hydrous Fe/Mn oxides in regulation of heavy metals in the environment remain unknown or poorly known. These include some of the scavenging mechanisms, selectivity of the hydroxides for given elements, and the quantitative importance of coatings in relation to other sinks, notably organic coatings. The interelemental relationships among hydroxides and heavy metals suggest that hydroxides may be useful in wastewater treatment and pollution control, and the economic recovery of useful metals from hydroxide coatings may be possible. (Rochester-IVI)
W86-00852

ASBESTOS IN DRINKING WATER
Department of National Health and Welfare, Ottawa (Ontario). Health Protection Branch.
P. Toft, M. E. Meek, D. T. Wigle, and J. C. Meranger.
CRC Critical Reviews in Environmental Control, Vol. 14, No. 2, p 151-197. 2 Fig, 11 Tab, 153 Ref.

Descriptors: *Asbestos, *Drinking water, *Public health, Transmission electron microscopy, Electron microscopy, Water pollution effects, Source of pollutants, Water treatment.

Methods of detection of asbestos in water, human exposure to asbestos in water, with emphasis on Canadian studies, and health effects of ingested asbestos are reviewed. Transmission electron microscopy with selected area electron diffraction is currently the best analytical method for determination of asbestos in drinking water. Concentrations of asbestos in drinking water range up to 2,000 million fibers/liter, but most samples analyzed have contained less than 10 million fibers/liter. 'Conventional' water treatment substantially reduces asbestos concentrations, although corrosive drinking waters may leach asbestos from asbestos-cement water mains. Epidemiological studies, all but one of which were ecological, have been insensitive and did not control for a number of potentially confounding variables. They did, however, provide some evidence for an association between ingested asbestos and cancer induction. No conclusive evidence for carcinogenicity or cocarcinogenicity of ingested asbestos has resulted from toxicological studies conducted with laboratory animals. Transmigration of asbestos fibers across the gastrointestinal wall cannot be ruled out, but there is little evidence for its widespread occurrence. The risk of developing disease from ingestion of asbestos at the concentrations found in most drinking water supplies is probably very small. Available information is insufficient to permit meaningful estimation of the magnitude of risk. (Rochester-IVI)
W86-00853

HEAVY METAL IN ISOPODS FROM THE SUPRA-LITTORAL ZONE ON THE SOUTHERN SHORE OF THE SEVERN ESTUARY, UK,
Bristol Univ. (England). Dept. of Botany.
S. P. Hopkin, M. H. Martin, and S. J. Moss.
Environmental Pollution (Series A), Vol. 9, No. 4, p 239-254, 1985. 1 Fig, 6 Tab, 48 Ref.

Descriptors: *Heavy metals, *Littoral zone, *Isopods, *Severn Estuary, *England, Zinc, Cadmium, Lead, Copper, Path of pollutants, Litter, Seaweed, Food, Smelters.

The concentrations of zinc, cadmium, lead and copper in the tissues of the littoral isopod Ligia oceanica from the three sites near to a primary zinc, lead and cadmium smelting works on the

southern shore of the Severn Estuary and an unpolluted site in the Menai Strait, Anglesey (England), were determined. The concentrations of zinc, cadmium and copper in whole L. oceanica from the contaminated sites were significantly higher than in specimens from the uncontaminated site, although the levels were only about one-and-a-half, three to four and twice as great, respectively. The amounts of lead in L. oceanica from all four sites were very small. The hepatopancreas was the most important storage organ of heavy metals and, at all sites, contained more than 50% of the total zinc, cadmium and copper in the body. The concentrations of heavy metals were compared in the tissues of L. oceanica and in two 'more terrestrial' isopods, Oniscus asellus and Porcellio scaber, collected from the same habitat at one of the contaminated sites. The mean concentrations of copper were the same in the hepatopancreas of all the isopods. However, there were large differences in the extent to which zinc, cadmium and lead had been accumulated by this organ in the three species. Analysis of the gut contents of the isopods revealed that all three species had been feeding on leaf litter derived from nearby trees, rather than on seaweed washed up onto the shore. Therefore, it was concluded that the extent to which zinc, cadmium and lead were assimilated by L. oceanica, O. asellus and Porcellio scaber must have been related to differences in their digestive physiology, rather than to choice of food material containing different concentrations of metals. (Author's abstract)
W86-00865

SORPTION OF MERCURY(II) BY HUMIC ACIDS,

Newcastle Univ. (Australia). Dept. of Chemistry.
P. Thanabalasingam, and W. F. Pickering.

Environmental Pollution (Series A), Vol. 9, No. 4, p 267-279, 1985. 3 Fig, 20 Ref.

Descriptors: *Mercury, *Fate of pollutants, *Humic acids, *Adsorption, Sediments, Hydrogen ion concentration, Calcium, Magnesium, Ammonium, Sulfates, Streams.

In a lake or closed estuary system, 90-99% of the total Hg present (predominantly inorganic species) may be associated in the sediments, with most of the residual fraction being associated with suspended particles. In experiments, uptake of Hg(II) (1-10 mg/l) by two humic acids varied with pH, with > 98% being sorbed at pH 4-5. Langmuir plots yielded adsorption capacity and bonding values of approximately 50 mmol/kg and 3,000,000 l/mol respectively. The addition of increasing amounts of chloride reduced uptake (10-20%) and shifted the maximum sorption region to higher pH values. The presence of 0.01 M levels of Ca(2+), Mg(2+) and NH4(+) promoted near total adsorption and reduced the pH effect; 0.001 levels slightly increased the amount of Hg(II) sorbed. Sulfate additions reduced Hg uptake. Much of the Hg(II) is considered to be chemisorbed, since while most of the sorbed species was extractable in 0.005 M EDTA, only half was released into 1 M HNO3 and molar salt solutions retrieved less than a third. The presence of humic acids in a sediment ensures that any added Hg(II) will become firmly bound to the solid phase, with levels in the adjacent aqueous phase being maintained at the < 50 micro-g/l level. With > 98% of any added Hg being retained, a high input rate into a natural system may result in rapid saturation of the surface of sediment beds. At the same time, with equilibrium favoring the solid phase it would seem that transport of Hg along streams will be associated mainly with suspended colloidal particles. (Moore-IVI)
W86-00866

PERSISTENCE OF ALDRIN IN FLOODED SOIL UNDER THE COVER OF RICE,

Haryana Agricultural Univ., Hissar (India). Dept. of Entomology.
G. Singh, T. S. Kathpal, K. S. Kushwaha, and G. S. Yadav.

Ecotoxicology and Environmental Safety, Vol. 9, No. 3, p 294-299, June, 1985. 2 Tab, 18 Ref.

Descriptors: *Flooded soil, *Rice, *Aldrin, Pesticide residues, Dieldrin, Fate of pollutants, Soil contamination, Flooding.

The persistence of aldrin in soil and its translocation into rice plants and grains were tested under two different field conditions. Treatment T1, which consisted of aldrin application at the rate of 1.5 kg active ingredient/ha at nursery sowing, did not leave aldrin residues in rice plants 40 days after application (10 days after transplanting). Dieldrin was present in plants to the extent of 0.04 ppm at this stage but completely disappeared (below detectable limit) within 70 days (30 days after transplanting). Treatment T2 involved aldrin application 10 days after transplanting in flooded soil at the same rate and left 0.518 ppm residues in soil just after application. These residues dissipated to their half in 90 days. At this stage its conversion to dieldrin was also observed. Remaining residues dwindled to below the detectable limit in 270 days. Plant samples analyzed from this treatment at 7 and 30 days contained 0.079 and 0.169 ppm aldrin and 0.025 and 0.08 ppm dieldrin, respectively. Rice grains also had aldrin and dieldrin residues (each at 0.001 ppm level) at harvest time but these were below the Maximum Tolerance Limits. Both the treatments were found safe from the toxic residue point of view. (Author's abstract)
W86-00875

EXAMPLE OF INTERACTION BETWEEN ENVIRONMENTAL POLLUTANTS: MODIFICATION OF THIRAM TOXICITY TO FRESHWATER ORGANISMS BY NITRITES OR NITRATES IN RELATION TO NITROSAMINE SYNTHESIS,

Rouen Univ., Mont-Saint-Aignan (France). Lab. de Toxicologie.

For primary bibliographic entry see Field 5C.
W86-00877

OCCURRENCE OF CHLORINATED POLYNUCLEAR AROMATIC HYDROCARBONS IN TAP WATER,

National Inst. for Environmental Studies, Tsukuba (Japan). Div. of Chemistry and Physics.
H. Shiraishi, N. H. Pilkington, A. Otsuki, and K. Fuwa.

Environmental Science and Technology, Vol. 19, No. 7, p 585-590, July, 1985. 4 Fig, 4 Tab, 19 Ref.

Descriptors: *Polynuclear aromatic hydrocarbons, *Chlorinated hydrocarbons, *Drinking water, Aromatic compounds, Hydrocarbons, Pollutant identification, Gas chromatography, Mass spectrometry, Chlorination, Raw water, Tsukuba, Japan.

The combination of a modified continuous liquid-liquid extraction and computerized gas chromatography/mass spectrometry using a fused silica capillary column enabled analysis of low concentrations of organic compounds in water. Tap water and raw water from Tsukuba, Japan were analyzed using this method. Monochlorinated derivatives of naphthalene, dibenzofuran, fluorene, fluorenone, phenanthrene, and fluoranthene and dichlorinated derivatives of naphthalene, phenanthrene, and fluoranthene were present in the tap water. The parent polynuclear aromatic hydrocarbons (PAHs) and their oxygenated derivatives such as fluorenone and anthraquinone were also found. Chlorinated PAHs were found in tap water at 0.1 to 0.01 ng/L levels, but were not found in the raw water. The presence of PAHs and chlorinated PAHs in tap water indicates the reaction of PAHs with residual chlorine. (Moore-IVI)
W86-00895

CARBONIZED COAL PRODUCTS AS A SOURCE OF AROMATIC HYDROCARBONS TO SEDIMENTS FROM A HIGHLY INDUSTRIALIZED ESTUARY,

Texas A and M Univ., College Station. Dept. of Oceanography.
E. G. Merrill, and T. L. Wade.

Environmental Science and Technology, Vol. 19, No. 7, p 597-603, July, 1985. 7 Fig, 2 Tab, 35 Ref.

Descriptors: *Carbonized coal products, *Hydrocarbons, *Polynuclear aromatic hydrocarbons, *Sediments, Water pollution sources, Estuarine environment, Creosote, Oil pollution, Tar, Aromatic compounds, Carcinogens, Elizabeth River, Virginia.

Sediments near large urban areas may contain high concentrations of anthropogenic hydrocarbons due to their proximity to source areas. Elizabeth River (Virginia) sediments are contaminated with high levels of hydrocarbons (0.1-2.9 mg/g). Hydrocarbon distributions in carbonized coal products (creosote, coal tar, roofing tar, and creosoted wood) were compared to that of ship stack and woodstove soot, crude oil, fuel oil, and a fuel oil spill. Hydrocarbon distributions characteristic of carbonized coal products were used to estimate the level of creosote contamination in these sediments. Elizabeth River sediments are contaminated with hydrocarbons from both carbonized coal and petroleum products. Carbonized coal products appear to have point sources associated with creosoting facility sites and are the main source of carcinogenic polynuclear aromatic hydrocarbons in the sediments. Petroleum products appear to have many sources, are highly weathered before reaching the sediments, and are the main source of the unresolved complex mixture. Carbonized coal products may contain compounds in addition to hydrocarbons (such as phenols) that may increase their environmental impact. (Moore-IVI)
W86-00896

FACTORS AFFECTING LEACHING OF NUTRIENTS FROM AN INTENSIVELY MANAGED GRASSLAND IN COUNTY ANTRIM, NORTHERN IRELAND,

Department of Agriculture for Northern Ireland, Antrim. Freshwater Biological Investigation Unit.
C. Jorden, and R. V. Smith.

Journal of Environmental Management, Vol. 20, No. 1, p 1-15, January, 1985. 4 Fig, 4 Tab, 32 Ref.

Descriptors: *Leaching, *Nutrients, *Grasslands, *Northern Ireland, Nitrogen, Phosphorus, Drainage, Grazing, Particulate matter, Nitrates, Ammonium, Manure, Pasture management.

Losses of nitrogen and phosphorus from intensively managed grassland were monitored daily. Cluster and factor analysis of the weekly loadings of the various nitrogen and phosphorus fractions indicated that the data could be divided into two main groups of variables. The first group included flow, soluble kjeldahl nitrogen and nitrate nitrogen; the second group included soluble reactive phosphorus, soluble organic phosphorus and ammonium nitrogen. Particulate phosphorus and particulate kjeldahl nitrogen shared some characteristics of both groups, but tended to be more similar to group two above. The loadings of the nitrogen fractions in the first group were principally determined by the flow through the drain - an increase in flow led to a proportionate increase in the loadings of soluble kjeldahl and nitrate nitrogen. Slurry (liquid manure) application and grazing during periods when the soil was close to saturation led to much larger losses of soluble reactive phosphorus, soluble organic phosphorus, ammonium nitrogen, particulate kjeldahl nitrogen and particulate phosphorus, than losses of soluble kjeldahl nitrogen and nitrate nitrogen. Slurry applications, silage cuts and grazing during dry periods led to negligible losses of nitrogen and phosphorus. Greatest losses of nitrate occurred after heavy rainfall following prolonged dry periods and were particularly evident in the autumn of 1982 and winter of 1983-84. (Author's abstract)
W86-00903

FACTORS INFLUENCING HYDROCARBON DEGRADATION IN THREE FRESHWATER LAKES,

Massachusetts Univ. at Boston. Environmental Science Program.
J. J. Cooney, S. A. Silver, and E. A. Beck.

Microbial Ecology, Vol. 11, No. 2, p 127-137, 1985. 1 Fig, 6 Tab, 14 Ref. OWRT grant B-060.

Descriptors: *Microbial degradation, *Lakes, *Fate of pollutants, *Hydrocarbons, Water pollu-

tion, Naphthalene, Pristane, Tetradecadiene, Hexadecane, Kerosene, Lake sediments, Limiting nutrients, Dissolved oxygen, Oil pollution, Water temperature, Bacteria.

The mixed microbial flora of 3 lakes on Ohio with differing histories of hydrocarbon pollution was examined in relation to the ability to use hydrocarbons. Weathered kerosene was spiked with naphthalene, pristane, 1,13-tetradecadiene, and n-hexadecane and added to water-sediment mixtures from the 3 lakes, and utilization of the 4 marker hydrocarbons was measured. Each of the marker hydrocarbons was metabolized; naphthalene was the most readily used and pristane was the most resistant. Values for dissolved oxygen suggest that oxygen did not limit hydrocarbon degradation in the water column at any site examined. Nutrient addition studies indicated that nitrogen and phosphorus limited hydrocarbon degradation at all sites examined. Maximum numbers of heterotrophic bacteria were detected when the water temperature was 10 C or higher. The data indicate that temperature limits hydrocarbon degradation in the winter, except at a site which had beem impacted by an oil spill and which received chronic inputs by hydrocarbons and nutrients. In samples from that site, all 4 markers hydrocarbons were degraded at 0 C. Results of temperature and nutrient-addition experiments suggest that different seasonal populations of hydrocarbon users are selected at that site, but not at other lake sites. (Author's abstract)
W86-00909

COPPER TOXICITY TO CYANOBACTERIA AND ITS DEPENDENCE ON EXTRACELLULAR LIGAND CONCENTRATION AND DEGRADATION,
Liverpool Univ. (England). Dept. of Botany.
W. F. Jardim, and H. W. Pearson.
Microbial Ecology, Vol. 11, No. 2, p 139-148, 1985. 4 Fig, 26 Ref.

Descriptors: *Plectonema, *Copper, *Toxicity, *Ligands, Metals, Cyanophyta, Citrate, Nitrilotriacetic acid, Fate of pollutants, Biodegradation, Algae, Microorganisms.

In the environment, the amelioration of the toxic effects of ionic copper can be due to the complexation by naturally occurring ligands. Copper toxicity to the cyanobacterium Plectonema boryanum (UTEX 594) was investigated in the presence of citrate and nitrilotriacetic acid (NTA) using a copper-saturated culture medium. The copper-citrate complex was biodegradable, and toxicity was dependent on the free ligand concentration. The ratio of citrate to copper also affected the extent of metal toxicity. NTA was not degraded by P. boryanum. Ligand degradation in the cyanobacterial culture increased the ionic copper concentration and caused a concomitant reduction in growth. Care must be taken when choosing complexing compounds to be used in metal toxicity tests involving microorganisms, since if the compounds are degraded, conditions will alter markedly during the course of the experiment. The bioavailability of citrate (and thus presumably other organic ligands), even when strongly complexed by metals, has ecological implications. Consumption of the ligand by heterotrophs may increase metal toxicity by increasing the ionic concentration, and this may actually coincide with a decrease in the soluble metal concentrations. (Moore-IVI)
W86-00910

5C. Effects Of Pollution

EFFECTS OF TREATED SEWAGE EFFLUENT AND BAY-BOTTOM MUD ON GROWTH OF MARINE PHYTOPLANKTON,
K. Kobayashi, N. Imada, and Y. Oshima.
Science Bulletin of the Faculty of Agriculture, Kyushu University, Vol. 39, No. 4, p 143-151, March, 1985. 4 Fig, 4 Tab, 19 Ref.

Descriptors: *Eutrophication, *Wastewater pollution, *Phytoplankton, *Estuarine environment, *Bays, *Sediments, Nitrogen, Phosphorus, Water pollution effects, Coastal waters, Mud.

As nitrogen and phosphorus sources, the treated sewage effluent and the bay-bottom and mud promote the eutrophication of estuarial and coastal areas, especially closed bays. The present paper deals with the effects of the treated sewage effluent and the bay-mud exudate on the growth of various phytoplankton species present in natural sea water. 1. Five sampling stations were set in the area receiving the effluent from Fukuoka Eastern Sewage Disposal Plant. 2. Throughout six investigations from May to November in 1979, the major phytoplankton occurring at the sampling stations were nine species of Bacillariophyceae and one of Dinophyceae. 3. In summer, the surface water in eastern Hakata Bay was extremely deficient both N and P or N, especially at the bottom of phytoplankton. 4. The average concentrations of NH4-N, NO3-N, NO2-N, org. N, PO4-P and org. P of the treated sewage effluents used for the N, P enrichment of media were 19.2 3.71, 0.1, 0.94, 2.64 and 0.20 mg/l, and those of bay-mud exudates were 20.8, tr., tr., 1.47, 3.35 and 0.49 mg/l, respectively. 5. In the N, P enriched media with NP-water (NO3-N, 16 mg/l; PO4-P, 2 mg/l), the cell number of almost all phytoplankton species seeded with natural sea water increased with increasing N, P concentrations of the media. In the media enriched with the treated sewage effluent and the bay-mud exudate, however, the growth of most phytoplankton species except Skeletonema costatum and Thalassiosira sp. were inhibited with increasing concentrations of the sewage effluent and the bay-mud exudate in the media. 6. The difference of susceptibility among phytoplankton species to some growth inhibitors which are contained in the sewage effluent and released from the bay-bottom mud may be a factor causing some dominant species in the plankton community. (Author's abstract)
W86-00616

REPLACEMENT OF STENONEMA SPP. BY CAENIS DIMINUTA WALKER AS THE NUMERICAL DOMINANT IN THE MAYFLY ASSEMBLAGE OF A THERMALLY-STRESSED STREAM,
Colorado State Univ., Fort Collins. Dept. of Zoology and Entomology.
N. L. Poff, and R. A. Matthews.
Journal of Freshwater Ecology, Vol. 3, No. 1, p 19-26, June, 1985. 3 Fig, 1 Tab, 26 Ref. DOE contract DE-AC09-76SR00001.

Descriptors: *Mayflies, *Thermal pollution, *Species composition, Water pollution effects, Aquatic insects, Streams, Heated water, Effluent.

Mayfly community structures in a thermally-stressed, previously thermally-stressed and an undisturbed stream were compared based on nymphal colonization of leaf packs incubated over a 48 d period from December 1982 to February 1983. Temperatures ranged from 7-31 C in the thermally-stressed stream and from 4-12 C in the other two streams. Accumulated degree days (>OC) were 734, 340 and 322 for the thermally-stressed, post-stressed and undisturbed streams, respectively. Stenonema spp. numerically dominated the mayfly fauna over the sampling period in the undisturbed (70%) and post-stressed (98%) streams, but was replaced by Caenis diminuta Walker (88%) in the stream receiving thermal effluent from a nuclear production reactor. Caenis diminuta is tolerant of rapidly fluctuating (delta T > 11 C/hr) and high temperatures (possibly up to 40 C). (Author's abstract)
W86-00617

EFFECTS OF SEWAGE ON LAKE CHAMPLAIN WETLAND,
Florida Univ., Gainesville. Center for Wetlands.
L. N. Schwartz, and G. K. Gruendling.
Journal of Freshwater Ecology, Vol. 3, No. 1, p 35-46, June, 1985. 1 Fig, 5 Tab, 33 Ref.

Descriptors: *Wastewater pollution, *Wetlands, *Water pollution effects, *Productivity, Food chain, Trophic level, Phytoplankton, Nutrients, Bacteria, Particulate matter, Lake Champlain, New York, Vermont.

Stevens Brook wetland is presently receiving partially treated sewage from the City of St. Albans, Vermont. The water quality in St. Albans Bay is deteriorating. There is conflicting evidence for the theory that wetlands act as a nutrient sink or as a biotic nutrient filter. This research is an investigation into the productivity and trophic food chain relationships of Stevens Brook wetland. This is compared to a non-impacted area, Scomotion Creek Wetland in Plattsburgh, New York. Temperature, pH, dissolved oxygen, transparency, alkalinity, conductivity, sodium, potassium, calcium, magnesium, nitrate, total phosphorus, bacteria, phytoplankton, aquatic macrophytes, and benthic invertebrates were sampled in both wetlands. The data indicate that excessive nutrients and a large carbon source result in high phytoplankton productivity and bacterial growth. This coupled with particulate matter causes low transparency and thus a decrease in submergent vegetation and a decrease in invertebrate faunal diversity. Increased production is not converted to additional biomass of consumers but is exported to the downstream water body. Thus, Stevens Brook wetland appears to be a pass-through system rather than a storage system, and is not effective in tertiary treatment of sewage effluent. (Author's abstract)
W86-00619

DISTRIBUTION OF ALUMINUM IN THE TISSUES OF THREE FISH SPECIES,
Northwestern State Univ. of Louisiana, Natchitoches. Dept. of Biological Sciences.
D. J. Berg, and T. A. Burns.
Journal of Freshwater Ecology, Vol. 3, No. 1, p 113-120, June, 1985. 5 Tab, 18 Ref.

Descriptors: *Aluminum, *Fish, *Alum, *Water pollution effects, Chaplin Lake, Louisiana, Water treatment wastes, Effluents, Catfish, Shad, Largemouth bass.

The use of alum (aluminum sulfate) to decrease the turbidity of public drinking water is a common practice in Louisiana. Alum acts as a source of positive electrolytes which neutralize negatively-charged soil particles, causing them to settle out of the water and produce a gelatinous sludge. Natchitoches, Louisiana pumps approximately 900 kg of such sludge into Chaplin Lake each day. Tissue aluminum levels in channel catfish, gizzard shad and largemouth bass were compared between Chaplin Lake, which receives water treatment plant effluent containing alum and a control lake. No significant correlations were found between tissue aluminum levels and age. Significant negative correlations were found between channel catfish brain and gill aluminum levels in individuals from Chaplin Lake and between gizzard shad brain aluminum levels and standard length. Liver and brain tissues had higher tissue aluminum concentrations than muscle and gill tissues. (Moore-IVI)
W86-00621

INFLUENCE OF OIL REFINERY EFFLUENTS ON THE STRUCTURE OF ALGAL COMMUNITIES,
Udai Pratap Coll., Varanasi (India).Dept. of Botany.
J. P. Gaur, and H. R. Kumar.
Archiv fur Hydrobiologie, Vol. 103, No. 3, p 305-323, May, 1985. 3 Fig, 10 Tab, 44 Ref.

Descriptors: *Water pollution effects, *Refineries, *Industrial wastes, *Algae, Species composition, Algal growth, Wastewater treatment, Plankton, Oil pollution, Phenols.

A survey of algal vegetation and chemical characteristics of wastewaters of Barauni, Gauhati, Gujarat, Madras and Cochin (India) refineries at different stages of treatment was made to have some ideas about the changes in algal community structure along the gradient of decreasing pollution load. During the initial stages of effluent treatment, effluents had high concentrations of oil and phenol as a result of which BOD and COD values were quite high. Several species of Oscillatoria and Phormidium were the sole contributors to total abundance of algal communities in the primary

treatment ponds. Diversity index was around 1 during the initial stage of treatment in oil separator tanks or clariflocculators. With the removal of phenol and oil and lowering of BOD and COD values, some representation of other algae occurred after the passage of effluent through various treatment processes. In conjunction with increase in species number up to the last treatment stage, there was a consistent decrease in apportionment of individuals in each species resulting in high (<3) diversity index at the outfall or the last treatment stage. Selected refineries showed marked resemblance in algal community structure despite the fact that they use different crude oils for refining operations and also different effluent treatment processes, and are located in different states of the country. The algal communities respond in a more or less predictable manner to severe stress of oil pollution. (Baker-IVI)
W86-00623

IN VITRO EFFECT OF MERCURIC CHLORIDE ON ACID AND ALKALINE PHOSPHATASE ACTIVITY OF A FRESHWATER PRAWN,
D.A.V. Coll., Muzaffarnagar (India). Pollution Relevant Research Lab.
R. Murti, Omkar, and G. S. Shukla.
Archiv fur Hydrobiologie, Vol. 103, No. 3, p 371-374, May, 1985. 2 Tab, 10 Ref.

Descriptors: *Water pollution effects, *Mercuric chloride, *Alkaline phosphatase, *Acid phosphatase, *Prawn, Toxicity, Heavy metals, Mercury compounds.

In vitro experiments were conducted to investigate the effects of mercuric chloride on acid and alkaline phosphatase activity in different tissues of freshwater prawn. Mercury was quite effective, inhibiting the activities of acid and alkaline phosphatases. The degree of inhibition increased with an increase in the concentration of the toxicant. Maximum inhibition in acid phosphatase activity was observed in 0.285 mg/l of mercuric chloride in hepatopancreas as compared to control whereas minimum inhibition was observed in the muscle (13%) after treatment with 0.095 mg/l HgCl2. Alkaline phosphatase activity was inhibited maximum in the stomach (33%) and minimum in the gill (10%) in 0.295 and 0.095 mg/l solutions respectively. In brain no significant inhibition in activity of alkaline phosphatase was noted. Maximum inhibition in acid phosphatase was noted in hepatopancreas (48%). It is concluded that alteration in the activities of these two phosphatases creates disturbances in the normal functioning of the various tissues of M. lamarrei. (Baker-IVI)
W86-00625

EFFECT OF PH ON TOXICITY OF SODIUM PENTACHLOROPHENATE TO FRY OF COMMON CARP IN SOFTWATER,
Delhi Univ. (India). Dept. of Anthropology.
B. S. Khangarot, A. Sehgal, and M. K. Bhasin.
Archiv fur Hydrobiologie, Vol. 103, No. 3, p 375-379, May, 1985. 1 Tab, 23 Ref.

Descriptors: *Water pollution effects, *Carp, *Toxicity, *Sodium pentachlorophenate, *Hydrogen ion conncentration, Organic compounds, Industrial wastes, Pesticides, Fish, Immature growth stages.

Pentachlorophenol and its salts, especially sodium pentachlorophenate (Na-PCP) are used extensively in industry and agriculture as fungicides, bactericides, insecticides and herbicides. Because of their widespread use, these pollutants ultimately reach to the aquaitc ecosystem and create water pollution problems. The acute toxicity of Na-PCP to fry of common carp was examined for 96 hr during bioassay tests. The influence of pH on toxicity of Na-PCP was examined for 48 hr. Most mortality from Na-PCP occurred within the 12 hr period. Immediately upon the introduction of Na-PCP fish showed hyperactivity. The behavioral responses of fry varied according to test concentration and pH. At lower pH, test concentrations are more toxic therefore, test animal showed more behavioral changes as compared to similar higher pH test concentration. In general fry responded to Na-PCP by an increase in swimming activity, surfacing, loss of schooling and equilibrium followed by swimming belly up and finally settling to the bottom before death. At higher pH concentrations fish were not affected until a few hours before death. (Baker-IVI)
W86-00626

EFFECTS OF AVAILABLE DIETARY CARBOHYDRATE AND WATER TEMPERATURE ON THE CHRONIC TOXICITY OF WATERBORNE COPPER TO RAINBOW TROUT (SALMO GAIRDNERI),
Waterloo Univ. (Ontario). Dept. of Biology.
D. G. Dixon, and J. W. Hilton.
Canadian Journal of Fisheries and Aquatic Sciences, Vol. 42, No. 5, p 1007-1013, May, 1985. 5 Tab, 29 Ref.

Descriptors: *Copper, *Toxicity, *Trout, *Diets, *Carbohydrates, *Water temperature, Heavy metals, Acclimation, Fish, Growth, Mortality.

A factorial design was used to determine the effects of dietary carbohydrate content (0.1 or 25.6%) and temperature (10 or 15 C) on the chronic toxicity of waterborne copper (0 or 144 micro-g Cu/L) to rainbow trout (Salmo gairdneri) over a 12-wk period. Relative to those on the low-carbohydrate (LC) diet, trout reared on the high-carbohydrate (HC) diet developed enlarged, glycogen-filled livers and attained reduced final mean wet body weights. This response was more pronounced at 10 than at 15 C. Whereas Cu exposure had no significant effect on the growth or mortality of either LC or HC fish at 15 C, or LC fish at 10 C, HC fish at 10 C showed significantly reduced final weight and increased mortality. Trends toward reduced liver glycogen and increased serum glucose, characteristic of chronic stress, were apparent in all Cu-exposed fish. In Cu-free water, mean Cu concentrations in liver tissue of HC fish were significantly lower than those in LC fish at both temperatures. Copper exposure resulted in significant increases in liver Cu concentration for all diet treatments except HC at 10 C. Elevated serum sorbitol dehydrogenase levels, indicative of hepatic damage, were apparent in Cu-HC fish at 15 C and in HC, Cu-HC, and Cu-LC fish at 10 C. No treatment effects on either serum protein or hematocrit were evident. The treatments during the growth period affected subsequent lethal tolerance of Cu. While the 96-h Cu LC50 was not significantly altered by diet alone at 15 C, it was elevated in HC fish, relative to LC fish at 10 C. The Cu LC50 of Cu preexposed fish was significantly elevated, relative to parallel groups held in Cu-free water, for LC fish at both 10 and 15 C. This acclimation to Cu was not apparent in HC fish at either temperature: no significant elevation in LC50 occurred as a result of preexposure. It is concluded that increased dietary carbohydrate can significantly increase the chronic toxicity of Cu to trout, and that the impact is enhanced by reduced water temperature. (Author's abstract)
W86-00630

BACTERIOLOGICAL SURVEY OF TWO ACID-STRESSED LAKES IN THE POCONOS BEFORE LIMESTONE APPLICATION,
Lafayette Coll., Easton, PA. Dept. of Biology.
S. K. Majumdar, G. Rall, A. Mrowca, P. Steed, and J. Tabak.
Proceedings of the Pennsylvania Academy of Science, Vol. 58, No. 2, p 181-186, 1984. 7 Tab, 26 Ref.

Descriptors: *White Deer Lake, *Bruce Lake, *Pennsylvania, *Acid rain, *Water pollution effects, *Bacteria, Lake sediments, Lakes, Water analysis, Water temperature, Seasonal variation, Sulfur bacteria.

Water and sediment samples were examined from two acidified lakes (White Deer, water pH range 4.4-6.6, and Bruce Lake, water pH range 5.9-6.6) in the Pocono Mountains of Pennsylvania to assess the impact of acid-stressed conditions on bacterial communities and densities prior to neutralization. Temperature values in water ranged from a low 9.5 in November to a high of 27.6 degrees C in June. In general, for both lakes, as the day length and temperature increased, pH values increased and bacterial populations, in most cases, increased. Bacterial counts during the summer and early fall months were elevated for all types of bacteria, except for the Pseudomonas types which remained consistently low throughout. The bacterial densities showed a seasonal pattern. The nitrogen cycle and sulfur cycle bacteria recovered from the spot plate method and the most probable number procedure, showed variations in total bacterial numbers in the water and sediment samples of both White Dear Lake and Bruce Lake. The Pseudomonas bacteria in both lakes were low at all four sediment sites. The sulfur cycle bacteria recovered by the MPN method also reflected low numbers. The sulfur reducers are found in a moderate amount ranging from 400 to 52,000 cells per ml of sediment slurry, while the sulfur oxidizers of the thio-oxidans group which favor a lower pH are not as prevalent, ranging from a low of 15 in November to a high of 10,000 cells per ml in June. The two acid stressed lakes in the Poconos are somewhat similar in bacterial communities and densities. The total bacterial flora present in the two lakes were markedly lower than those found in other non-acid-stressed lakes. (Baker-IVI)
W86-00634

RESPONSE OF A DETRITAL FOODWEB TO EUTROPHICATION,
Marine Biological Lab., Woods Hole, MA.
J. E. Hobbie, and J. J. Cole.
Bulletin of Marine Science, Vol. 35, No. 3, p 357-363, November, 1984. 7 Fig, 1 Tab, 18 Ref.

Descriptors: *Food chains, *Eutrophication, *Detritus, Bacteria, Protozoa, Marine environment, Plankton, Nutrients, Nitrogen, Phosphorus, Silica, Biomass, Primary productivity.

The response of planktonic bacteria and microprotozoa to an experimental eutrophication gradient in coastal marine waters was investigated. Bacterial and microflagellate numbers, as well as glutamic acid mineralization and tritiated thymidine incorporation, were measured in a series of 13 cu m mesocosms for 6 months. The systems received a daily addition of sea water (3.7% of total) and nutrients so that the nutrients added were 0, 2, 4, 16 and 32 times the anthropogenic nitrogen, phosphorus and silica loading of Narragansett Bay, Rhode Island. Both the biomass and primary production of the planktonic algae increased in direct response to nutrient loading through the 16x treatment; the response in the 32x treatment equalled that of the 16x treatment. In general, bacterial numbers and growth (calculated from thymidine uptake) were higher in the more eutrophic tanks but there were lags in the microbial response to the peaks and valleys of the algal growth. These lags caused poor correlation between instantaneous measurements of microbial and algal parameters such as numbers of bacteria and algal production. However, when daily production was summed for the entire 6 months of the study there was excellent correlation between the total algal production and the total bacterial production ($r = 0.89$) for six tanks. It is difficult to convert from thymidine incorporation to absolute quantities of bacterial production. A conservative conversion factor derived from laboratory values for the thymidine content of bacterial cells was used to calculate bacterial production. Bacterial production (respiration plus growth) was nearly a constant fraction of planktonic primary production at all levels of eutrophication and averaged 31%. The results are in good agreement with other estimates of the carbon flux through the detrital component of pelagic ecosystems. (Author's abstract)
W86-00638

MACROBENTHIC INVERTEBRATES OF A PERTURBED STREAM IN SOUTHERN NIGERIA,
Benin Univ., Benin City (Nigeria). Dept. of Zoology.
R. Victor, and D. T. Dickson.
Environmental Pollution (Series A), Vol. 38, No.

21 p 99-107, 1985. 2 Fig, 1 Tab, 14 Ref.

Descriptors: *Invertebrates, *Benthic fauna, *Ikpoba River, *Nigeria, Stress, Oligochaetes, Chironomids, Water pollution effects, Wastewater pollution, Storm runoff, Aquatic insects.

The Ikpoba River is a fourth order stream flowing from north to south through Benin City, Bendel State, Southern Nigeria. In its upper reaches, the stream flows through a dense rainforest where surface run-off and organic matter from the surrounding vegetation contribute to allochtonous input. In the outskirts of the city, riparian settlements are thinly populated, so that disturbance due to human activities is low and localized. The stream is considerably perturbed while flowing through the city. The University of Benin and its Teaching Hospital discharge sewage sludge into forest clearings near the right bank and at least part of these effluents are likely to enter the stream via runoff and seepage. It also receives stormwater runoff from bordering agricultural lands and urbanized areas. The Ikpoba weir impounds the stream further downstream to form an artificial reservoir. A total of nine taxa were collected in the study stretch. The insects were represented by larvae or nymphs of six families: Chironomidae, Ceratopogonidae, Baetidae, Hydroptilidae, Parnidae and Corduliidae. The oligochaetes were represented by one family, Naididae. The most striking feature of the study area is the overall low diversity of macrobenthic invertebrates. The abundance of macrobenthos in the three stations was variable. The important factors governing the occurrence and distribution of macrobenthos are the physicochemical qualities of the water and the immediate substrate of occupation. Any severe alterations of these factors will substantially affect the macrobenthos. The combination of substrate obliteration and poor water quality, especially the low dissolved oxygen content seem to be controlling the macrobenthos in some instances. (Baker-IVI)
W86-00652

TOXIC EFFECTS OF IRON ORE TAILINGS AND THE RESPONSE OF WATERCRESS FROM TAILINGS AT HIGH CONCENTRATIONS OF FE, ZN AND MN,
Chinese Univ. of Hong Kong, Shatin. Dept. of Biology.
M. H. Wong.
Environmental Pollution (Series A), Vol. 38, No. 2, p 129-140, 1985. 6 Fig, 5 Tab, 14 Ref.

Descriptors: *Mine wastes, *Manganese, *Zinc, *Iron, *Watercress, Seeds, Metals, Plants, Water pollution effects, Aquatic plants.

The vegetation growing on iron ore tailings is subject to a harsh environment, especially various adverse edaphic factors including the rather high contents of Mn, Fe and Zn. N. officinale (watercress) grows in waterlogged areas with its roots penetrating into the soil and part of the plant body submerged in water. The ability of N. officinale growing in iron ore tailings to produce plants tolerant to the comparatively high metal concentrations was investigated. Samples of watercress were collected from the tailings site, a cultivated area and noncultivated land. Metals present in plant tissue collected from the tailings were significantly higher than those collected from the other sites. Studies showed that 5, 10, and 15% water extracts of soil from the three sites reduced Brassica chinensis seed germination and root elongation. When the three different populations of N. officinale collected from the three sites were tested from metal tolerance by examination of root growth in a series of concentrations of manganese, iron and zinc separately, it was found that the tailings population had significantly higher values of tolerance for each of the three metals despite the fact it had only been growing on the site for three years. (Baker-IVI)
W86-00653

METHOD FOR AQUATIC MULTIPLE SPECIES TOXICANT TESTING: ACUTE TOXICITY OF 10 CHEMICALS TO 5 VERTEBRATES AND 2 INVERTEBRATES,
Environmental Research Lab.-Duluth, MN.
For primary bibliographic entry see Field 5A.
W86-00654

FATE AND EFFECTS OF ORGANOTIN COMPOUNDS,
California Univ., Berkeley. Dept. of Zoology.
For primary bibliographic entry see Field 5B.
W86-00665

DESTRUCTION OF WATER RESOURCES - THE MOST CRITICAL ECOLOGICAL CRISIS OF EAST ASIA,
International Union for Conservation of Nature and Natural Resources, New Delhi (India).
For primary bibliographic entry see Field 4C.
W86-00666

ALLIUM TEST ON RIVER WATER FROM BRAAN AND SAXAN BEFORE AND AFTER CLOSURE OF A CHEMICAL FACTORY,
Lund Univ. (Sweden). Inst. of Genetics.
For primary bibliographic entry see Field 5A.
W86-00667

GROWTH INHIBITION AND RECOVERY IN MUSSELS (MYTILUS EDULIS) EXPOSED TO LOW COPPER CONCENTRATIONS,
University Coll. of North Wales, Menai Bridge. Marine Science Labs.
K. J. Redpath.
Journal of the Marine Biology Association, Vol. 65, No. 2, p 421-431, 1985. 7 Fig, 1 Tab, 23 Ref.

Descriptors: *Copper, *Water pollution effects, *Mussels, *Animal growth, Heavy metals, Industrial wastes, Toxicity, Growth, Metals, Animal metabolism.

The shell growth of Mytilus edulis was investigated under the effects of a 10 day exposure to copper at six different concentrations. At concentrations greater than 2 micro g/l added copper, significant growth inhibition occurred. At 15 micro g/l added metal, growth almost ceased. At 6 micro g/l a 50% reduction of growth was noted. After the exposure period was completed, recovery was observed at all concentrations. The long term recovery pattern of Mytilus shell growth was studied after a 20 day exposure to copper also. Evidence was found of a growth overshoot after then end of the exposure period. The known effects of copper on the metabolism of mussels is included in the discussion of these findings. (Baker-IVI)
W86-00668

LONG-TERM ECOSYSTEM STRESS: THE EFFECTS OF YEARS OF EXPERIMENTAL ACIDIFICATION ON A SMALL LAKE,
Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
D. W. Schindler, K. H. Mills, D. F. Malley, D. L. Findlay, and J. A. Shearer.
Science, Vol. 228, No. 4706, p 1395-1401, June 1985. 2 Fig, 45 Ref.

Descriptors: *Water pollution effects, *Acid rain, *Lakes, *Acidification, *Ecosystems, Environmental effects, Fish, Food chains, Acidity, Water quality, Hydrogen ion concentration, Ontario.

An ecosystem scale experiment was conducted in Lake 223, a small Precambrian Shield lake surrounded by virgin boreal forest in the Experimental Lakes Area, and typical of poorly buffered small lakes of northwestern Ontario. Over a period of 8 years, the pH of the lake has been gradually decreased from 6.8 to 5.0 by the addition of sulfuric acid. The study revealed various apparent mechanisms of response of the lake's biota to increased acidity, ranging from direct toxicity of hydrogen ion to disruptions of normal food-chain relations, behavioral patterns of animals, and biogeochemical cycles in the lake. In some cases, synergistic interactions of several stresses appeared to be involved. Some of the adverse changes occurred much earlier in the acidification process than is commonly believed to cause ecosystem degradation. This suggests that ecological damage from lake acidification may be more extensive than previously believed. Changes in phytoplankton species, cessation of fish reproduction, disappearance of the benthic crustaceans, and appearance of filamentous algae in the littoral zone were consistent with deductions from synoptic surveys of lakes in regions of high acid deposition. Acidification did not cause decreases in primary production, rates of decomposition, or nutrient concentrations. Key organisms in the food web leading to lake trout, including Mysis relicta and Pimephales promelas, were eliminated from the lake at pH values as high as 5.8, an indicate that irreversible stresses occur early in the proceess. These changes are caused by hydrogen ion alone, and not by the secondary effect of aluminum toxicity. Since no species of fish reproduced at pH values below 5.4, the lake would become fishless within about a decade on the basis of the natural mortalities of the most long-lived species. (Baker-IVI)
W86-00688

METABOLISM OF ALDRIN BY THE FRESHWATER PLANARIAN PHAGOCATA GRACILIS,
Middle Tennessee State Univ., Murfreesboro. Dept. of Biology.
S. Post, and M. R. Wells.
Bulletin of Environmental Contamination and Toxicology, Vol. 34, No. 6, p 871-875, June, 1985. 1 Tab, 8 Ref.

Descriptors: *Aldrin, *Planaria, *Animal physiology, *Toxicity, Water pollution effects, Enzymes, Dieldrin, Chlorinated hydrocarbons, Pesticides, Insecticides.

Planarians (Phagocata gracilis) that were fed beef liver containing 125 ppm aldrin showed no ill effects and appeared to convert the pesticide to an unidentified hydrophilic compound, not to dieldrin. Planarians sacrificed at 40 min after feeding for 1 hr contained the highest level of aldrin (1.12 + or - 0.99 ppm). Neither dieldrin nor any other insecticide was recovered from tissue. After planarians were removed from the feeding dishes, an unidentified hydrophilic compound, which eluted after 5.35 min from a Varian model 3700 gas chromatograph packed with 11% OV-17+QF, by wt (80/100) on Gas Chrom Q. The compound was recovered from water samples of 2/3 groups sacrificed at 120 min and 3/3 groups sacrificed at 180 min. No aldrin epoxidase activity was detected in any subcellular fraction assayed. P. gracilis does not appear to convert aldrin to dieldrin. The hydrophilic compound detected in water samples from animals treated with aldrin suggests an alternate route of detoxification; this mechanism avoids the formation of another toxic compound by converting aldrin directly into a polar metabolite that is readily excreted into their aquatic environment. (Rochester-IVI)
W86-00693

PCBS IN STRIPED BASS COLLECTED FROM THE HUDSON RIVER, NEW YORK, DURING FALL, 1981,
State Univ. of New York at Albany. Dept. of Atmospheric Science.
R. J. White, H. T. Kim, and J. S. Kim.
Bulletin of Environmental Contamination and Toxicology, Vol. 34, No. 6, p 883-889, June, 1985. 2 Tab, 13 Ref.

Descriptors: *Polychlorinated biphenyls, *Hudson River, *New York, *Bass, *Fish, Bioaccumulation, Water pollution effects, Chlorinated hydrocarbons.

Analyses of striped bass (Morone saxatilis) filets from the Hudson River near Nyack, New York contained a mean concentration of polychlorinated biphenyls (PCBs) higher than 2 ppm. Comparison of peak to peak summation and pattern matching showed that the two techniques gave equivalent results. Trimming fish filets, by removing the skin and adipose tissue, resulted in significantly lower concentrations of PCB (1.3 + or - 0.6 micro-g/g wet weight versus 3.0 + or - 1.8 micro-g/g for the standard filets) from the same fish. Similar results

were obtained for hexane-extractable lipids. No correlation could be established between length of fish and PCB concentration. Trimming of filets reduced the average (but not all individual) tissue concentrations of PCBs to below the 2 ppm limit of safety established by the Food and Drug Administration. It is recommended that anglers employ the trimming procedure and limit the number of fish consumed. (Rochester-IVI)
W86-00695

EFFECTS OF CADMIUM AND COPPER ON CHEMOTAXIS OF MARINE AND FRESHWATER CILIATES,
Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
S. G. Berk, J. H. Gunderson, and L. A. Derk.
Bulletin of Environmental Contamination and Toxicology, Vol. 34, No. 6, p 897-903, June, 1985. 2 Tab, 16 Ref. U.S. EPA grant R809799.

Descriptors: *Protozoans, *Copper, *Cadmium, *Chemotaxis, *Animal behavior, *Water pollution effects, Metals, Heavy metals, Toxicity.

The chemotactic response of both freshwater and marine ciliates was affected by the presence of relatively low concentrations of copper or cadmium in the water. Ciliates (Tetrahymena sp., freshwater; Paranophrys sp., an unknown designated W5, and Maimiensis avidus; all marine) were allowed to seek yeast extract solution in capillary tubes, and the number of ciliates entering the tubes was measured. Copper caused swimming speed to increase, which gave the impression of stimulated chemotaxis, but in fact led to non-linear log-probit graphs for EC50, yielding meaningless values in some cases. Significant inhibition of chemotaxis was given by copper at 0.0050-0.25 ppm (Miamensis), 0.05-0.10 ppm (Paranophrys), 0.05-1.0 ppm (W5), and 0.25-1.00 (Tetrahymena) and by cadmium at 0.25-1.00 ppm (Tetrahymena), 4.0-25.0 ppm (Paranophrys), 5.0-25.0 (W5), and 10.0-25.0 ppm (Miamiensis). Copper was apparently more toxic than cadmium for marine ciliates, and the metals were equally toxic for the freshwater species. The inhibitory effects on Miamiensis of 15 min exposure to 0.5 ppm Cu were eliminated by washing the cells; similarly, the effects of Cd could be reversed by washing. Washing Tetrahymena did not eliminate the effects of exposure to 0.25 ppm Cu, but did nullify the effect of 1 ppm Cd. Sublethal concentrations of certain heavy metals in the natural environment may cause population reduction or elimination because animals become unable to locate areas of high food concentration. (Rochester-IVI)
W86-00696

TOXICITY AND ACCUMULATION OF COPPER AND CADMIUM IN THE ALGA SCENEDESMUS OBLIQUUS LH,
Vysoka Skola Zemedelska v Praze, Ceske Budejovice (Czechoslovakia). Faculty of Agricultural Economics and Management.
K. Drbal, K. Veber, and J. Zahradnik.
Bulletin of Environmental Contamination and Toxicology, Vol. 34, No. 6, p 904-908, June, 1985. 2 Tab, 12 Ref.

Descriptors: *Algae, *Scenedesmus, *Toxicity, *Bioaccumulation, *Copper, *Cadmium, Metals, Heavy metals, Water pollution effects, Chemical reactions.

Scenedesmus obliquus LH removes both Cu and Cd from an aquatic medium, but actual bioabsorption appears to be much lower than measured changes of the metals in the cultivation media. Initial experiments showed a removal efficiency of 83-97% for Cu and 78-99% for Cd when calculated on the basis of amount of heavy metal remaining in the supernatant medium. In parallel experiments without algae and without light, however, removal of 47-56% Cu and 61-78% Cd was observed, indicating that purely chemical precipitation accounted for much of the observed removal of metals. Studies conducted over periods ranging from 0.5-120 or 144 hr showed that removal efficiency generally increased between 0.5 and 24 hr for both metals in all experiments, but did not necessarily increase with increasing time after that. In all series, the removal efficiency at 120 or 144 hr was less than values attained at shorter times. The presence of 0.5 mg/l of each metal in the medium produced less inhibition of biomass accumulation over time than did 1 mg/l of each metal in the culture. Microscopic examinations showed no death of algal cells at either concentration in experiments lasting up to 144 hr. The inhibitory effect of Cu and Cd on the growth of S. obliquus at initial biomass concentrations of about 2 g/l dry wt is perceptible, and the algae apparently accelerate and increase the removal of copper and cadmium from the medium. (Rochester-IVI)
W86-00697

USE OF WATERSHED CHARACTERISTICS TO SELECT CONTROL STREAMS FOR ESTIMATING EFFECTS OF METAL MINING WASTES ON EXTENSIVELY DISTURBED STREAMS,
Illinois Univ. at Urbana-Champaign. Dept. of Ecology, Ethology and Evolution.
R. M. Hughes.
Environmental Management, Vol. 9, No. 3, p 253-262, 1985. 4 Fig, 3 Tab, 35 Ref. EPA grant R806391.

Descriptors: *Mine wastes, *Water pollution effects, *Streams, *Controls, *Watersheds, Sediments, Heavy metals, Stream pollution, Trout, Riparian vegetation, Invertebrates, Habitats.

Impacts of sediments and heavy metals on the biota of streams in the copper-mining district of southwestern Montana were examined by comparing aquatic communities of impacted streams with those of control streams. Control streams were chosen through the use of a technique that identifies similar streams based on similarities in their watershed characteristics. Signficant differences between impacted and control sites existed for surface substrate, riparian vegetation, and the number of macroinvertebrate taxa. These results revealed that: (a) chemical and physical habitats at the impacted sites were disrupted, (b) the presence of trout was an inadequate measure of ecological integrity for these sites, and (c) watershed classification based on a combination of mapped terrestrial characteristics provided a reasonable method to select control sites where potential control sites upstream and downstream were unsuitable. (Author's abstract)
W86-00725

SEPARATING STARVATION LOSSES FROM OTHER EARLY FEEDING FRY MORTALITY IN STEELHEAD TROUT SALMO GAIRDNERI, CHINOOK SALMON ONCORHYNCHUS TSHAWYTSCHA, AND LAKE TROUT SALVELINUS NAMAYCUSH,
New York State Dept. of Environmental Conservation, Albany. Bureau of Environmental Protection.
J. C. Skea, J. Symula, and J. Miccoli.
Bulletin of Environmental Contamination and Toxicology, Vol. 35, No. 1, p 82-91, July, 1985. 3 Fig, 4 Tab, 12 Ref.

Descriptors: *Starvation, *Mortality, *Trout, *Salmon, *Fish hatcheries, *DDT, *Fish toxicants, Fish physiology, Growth, Syndrome, Aquaculture.

Calculating time of exposure in terms of temperature units (TU = temperature in degrees C x hours at temperature / 24) made it possible to show that death of fry due to starvation occurred at a significantly different time from death due to toxic (DDT) syndrome in steelhead trout, lake trout, and chinook salmon from various water bodies in New York and Lake Michigan. This DDT syndrome, a condition which has been observed since 1964 in some species, includes death of fry characterized by distended air bladder, air in the intestinal tract, and erratic swimming. When unfed fish were separated according to source female, and held without feeding, death from DDT syndrome occurred in a peak occurring within approx 300 TU from 50% swim-up, regardless of the length of time required to reach this stage of maturation. The losses were female-dependent in steelhead trout. Chinook salmon from Lake Ontario did not exhibit syndrome, but steelhead trout from this lake did. The peak of mortality from starvation came a few hundred TU after the peak associated with DDT syndrome, and the appearance of fish dying of syndrome was very different from that of those dying of starvation. DDT syndrome loss, which is female-dependent, may result from pesticides or nutritional deficiencies during oogenesis and/or vitellogenesis; mortality that occurs after this period can be correlated with poor fry diet or other cultural causes. Recognition of the temporal separation of DDT syndrome losses from diet effects has already resulted in significant savings in production costs in the New York State hatchery system. (Rochester-IVI)
W86-00728

NITRITE EXPOSURE AND RESPIRATION RATES IN FATHEAD MINNOWS,
North Texas State Univ., Denton. Dept. of Biological Sciences.
D. E. Watenpaugh, and T. L. Beitinger.
Bulletin of Environmental Contamination and Toxicology, Vol. 35, No. 1, p 106-111, July, 1985. 1 Tab, 26 Ref.

Descriptors: *Nitrites, *Respiration rates, *Minnows, *Toxicity, Water pollution effects, Fish, Hardness, Oxygen consumption, Fish physiology, Animal physiology.

Acute exposure of fathead minnows (Pimephales promelas) to nitrite reduced their weight-specific oxygen consumption by about 22%. Acute (24 hr) static exposures of fish to nitrite were conducted in aerated, reconstituted hard water at 19 + or - 1 C. Minnows used weighed 0.60 + or - 0.15 g, and nominal doses of 0, 9, 18, and 27 mg/l NO2-N were employed, with replications of 15-20 fish per replicate. Routine respirometry measurements were conducted with individual fish in 300 ml bottles closed for 90 min at 19.2 + or - 0.2 C. Some fish died during exposure to nitrite and during subsequent respirometry; both types of mortality were significantly correlated with nitrite level. Most fish were minimally active during respirometry; severely stressed fish were somewhat less active. Mean weights of minnows from the various nitrite concentrations were not significantly different. Although mean routine respiration rate of minnows at the lowest nitrite exposure were not significantly lower than that of the controls, the rates of the fish receiving the two highest nitrite exposures were significantly lower than the controls. Although routine respiration rate determinations detected a sublethal effect of nitrite, such determinations are usually insensitive indicators of changes in metabolic rate induced by chemicals, because activity is unregulated. Effects of chemicals on metabolic rate are better evaluated with standard or active weight-specific oxygen consumption when possible. (Rochester-IVI)
W86-00729

RESPONSES OF MACROBENTHOS COLONIZING ESTUARINE SEDIMENTS CONTAMINATED WITH DRILLING MUD CONTAINING DIESEL OIL,
Environmental Research Lab., Gulf Breeze, FL.
M. E. Tagatz, G. R. Plaia, and C. H. Deans.
Bulletin of Environmental Contamination and Toxicology, Vol. 35, No. 1, p 112-120, July, 1985. 2 Tab, 20 Ref.

Descriptors: *Macrobenthos, *Estuarine environment, *Sediments, *Drilling mud, *Fuel, Water pollution effects, Mollusks, Annelids, Chordata, Arthropoda, Barium sulfate, Lime, Species composition, Ecological effects.

Communities of macrobenthos forming in field-colonized boxes containing drilling mud contaminated with diesel oil differed significantly in terms of numbers of individuals, numbers of species, and phylogenetic composition from boxes containing clean sand. Acrylic plastic boxes (32 x 32 x 6 cm deep) were positioned flush with the natural bottom surface at 3 m depth in Santa Rosa Sound

(Florida). They were filled with clean sediment, sediment containing lime drilling mud with 3.98 mg/g wet weight diesel oil, or sediment containing barium sulfate. Colonization was permitted for 8 wk, and all animals retained on a 1-mm mesh sieve were counted. A total of 1,081 animals representing 63 species and 10 phyla were collected. Mollusca, Annelida, Chordata, and Arthropoda were the dominant phyla. Only 24 and 32 spp occurred in the 1:3 and 1:10 lime-mud:sediment mixtures, respectively, compared to 43 spp in the control. Mollusks, particularly gastropods, and annelids were significantly affected. Although individuals and species were fewer in barite mixtures than in the control, only the species effect for combined phyla in 1:3 barite:sediment was significant. For all phyla combined, both the number of individuals and number of species in 1:3 mud mixtures differed significantly from those in barite mixtures; a significant difference in number of species was detected between the 1:10 mud mixtures and 1:10 barite mixtures. Species diversity, species dominance, and dissimilarity indices changed markedly only in communities exposed to 1:3 mud mixtures. Relative abundance of individual species for all treatments differed little from the control, as reflected by low Bray-Curtis dissimilarity indices; however, communities in 1:3 mud were most dissimilar. Indices calculated comparing the control with 1:10 barite, 1:3 barite, 1:10 mud, and 1:3 mud were 0.17, 0.20, 0.20, and 0.31, respectively. Species number and density were more sensitive and reliable indicators of stress than the biological indices employed. (Rochester-IVI)
W86-00730

ACUTE AND CHRONIC TOXICITY OF TECHNICAL PICLORAM (4-AMINO-3,5,6-TRICHLOROPICOLINIC ACID) TO DAPHNIA MAGNA STRAUS,
Dow Chemical U.S.A., Midland, MI. Mamammalian and Environmental Toxicology.
F. M. Gersich, D. L. Hopkins, and D. P. Milazzo.
Bulletin of Environmental Contamination and Toxicology, Vol. 35, No. 1, p 121-126, July, 1985. 1 Tab, 8 Ref.

Descriptors: *Toxicity, *Picloram, *Herbicides, *Daphnia, Water pollution effects, Bioassays, Pesticides.

Acute (48 hr) and chronic (21 day) toxicity studies with the herbicide compound picloram (4-amino-3,5,6-trichloropicolinic acid) indicate a comparatively low toxicity for the cladoceran Daphnia magna Straus. In the acute test, groups of 10 neonates were exposed to 12.7, 20.5, 34.5, 57.0, and 94.4 mg/l picloram; in the chronic test, neonates were allowed to grow and reproduce in glass tubes in solutions of 7.6, 11.8, 18.1, 29.6, and 46.9 mg/l picloram. The calculated 48-hr LC50 value was 68.3 mg (63.0-75.0 = 95% confidence interval). The no kill and 100% kill levels were 34.5 and 94.4 mg/l, respectively. The maximum acceptable toxicant concentration (MATC: based on mean total young/adult) estimated from the chronic study results was between 11.8 and 18.1 mg/l; the geometric mean value was 14.6 mg/l. Mean dry weight/adult was not statistically analyzed, nor was it used to estimate the MATC. The control mean dry weight/adult was 600 micro-g; all picloram-treated daphnids had a mean dry weight/adult of 500 micro-g, except the highest concentration, 46.9 mg/l, for which the value was 300 micro-g. The survival in the chronic test was from 90%-100% for the control and all picloram concentrations up to 29.6 mg/l, but was 60% for the 46.9 mg/l treatment (statistically significant at the 0.05 level). (Rochester-IVI)
W86-00731

PERCENT MORTALITIES AND LC50 VALUES FOR SELECTED MICROCRUSTACEANS EXPOSED TO TREFLAN, CUTRINE-PLUS, AND MSMA HERBICIDES,
Southern Univ., Baton Rouge, LA. Dept. of Biological Sciences.
S. M. Naqvi, V. O. Davis, and R. M. Hawkins.
Bulletin of Environmental and Toxicology, Vol. 35, No. 1, p 127-132, July, 1985. 2 Tab, 11 Ref. Louisiana Board of Regents, Research and Development Program project B-17.

Descriptors: *Herbicides, *Crustaceans, *Trifluralin, *Cutrine-plus, *Monosodium methanearsonate, *Toxicity, Water pollution effects, Arsenicals, Pesticides, Cladocerans, Calanoidians, Cyclopods, Ostracods,.

Three herbicides, Treflan (trifluralin), Cutrine-plus, and monosodium methanearsonate (MSMA), were shown to be toxic to a mixture of freshwater zooplankton collected in Lake Kernan, Louisiana. Treflan was much more toxic than the other two substances. LC50 values for Treflan (ppm) were as follows: Cladocera, 0.06; Calanoida, 0.08; Cyclopoida, 0.05; and Ostracoda, 0.06. Comparable values for Cutrine-plus were 11.3 12.21, 12.4, and 12.5, respectively, at a CaCO3 hardness of 140 mg/l. For the same compound at 280 mg/l CaCO3 hardness, respective LC50 values were raised to 18.5, 12.6, 16.4, and 15.3 ppm. MSMA was least toxic, with 48-hr LC50 values of 39.3, 37.6, 96.3, and 98.2 ppm, respectively, for Cladocera, Calanoida, Cyclopoida, and Ostracoda. Forty-eight-hour LC99 values for all microcrustacean groups together were 1.3-1.9 ppm for Treflan, 28.4-37.7 ppm for Cutrine-plus in soft water, 40.4-80.5 ppm for Cutrine-plus in medium hard water, 33.4-129.1 ppm for Cutrine-plus in very hard water, and 133.9-781.2 ppm for MSMA. Microcrustaceans were identified only to generic level (Alonella sp., Cladocera; Diaptomus sp., Calanoida; Eucyclops sp., Cyclopoida; and Cypria sp., Ostracoda). (Rochester-IVI)
W86-00732

AQUATIC BIOASSAY OF 11 PESTICIDES USING LARVAE OF THE MOSQUITO, WYEOMYIA SMITHII (DIPTERA: CULICIDAE),
Air Force Occupational and Environmental Health Lab., Brooks AFB, TX.
For primary bibliographic entry see Field 5A.
W86-00733

ENVIRONMENTAL AND ECONOMIC DAMAGE CAUSED BY SEDIMENT FROM AGRICULTURAL NONPOINT SOURCES,
Tennessee Valley Authority, Knoxville. Environmental Quality Staff.
A. M. Duda.
Water Resources Bulletin, Vol. 21, No. 2, p 225-234, April, 1985. 3 Fig, 1 Tab, 56 Ref.

Descriptors: *Nonpoint pollution sources, *Sediments, *Water pollution effects, Water quality, Agriculture, Soil erosion, Economic aspects, Environmental effects.

Environmental and economic damages caused by agricultural nonpoint source inputs of sediment and associated pollutants are examined. Widespread water quality problems are identified in lakes, rivers, and estuaries in agricultural areas, and billions of dollars of onsite and offsite costs result from this eroded soil every year. Some water bodies have been irretrievably damaged, and expensive rehabilitation programs are needed to remedy in-place water pollution problems if Clean Water Act goals are to be achieved. Unless effective abatement and rehabilitation programs are established, billions of dollars of benefits to future generations will not be realized as more waters become irretrievably damaged, and billions more will continue to be spent by government to treat symptoms of these sediment-related problems. (Author's abstract)
W86-00784

GOLD-MINING EFFECTS ON STREAM HYDROLOGY AND WATER QUALITY, CIRCLE QUADRANGLE, ALASKA,
Alaska Univ., Fairbanks. Inst. of Water Resources.
For primary bibliographic entry see Field 4C.
W86-00785

GOLD-MINING EFFECTS ON HEAVY METALS IN STREAMS, CIRCLE QUADRANGLE, ALASKA,
Alaska Cooperative Fishery Research Unit, Fairbanks.
J. D. LaPerriere, S. M. Wagener, and D. M. Bjerklie.
Water Resources Bulletin, Vol. 21, No. 2, p 245-252, April, 1985. 1 Fig, 7 Tab, 9 Ref. EPA project 808340-01.

Descriptors: *Gold mining, *Heavy metals, *Stream pollution, *Circle Quadrangle, *Alaska, Placer mining, Mine wastes, Arsenic, Mercury, Lead, Zinc, Copper, Cadmium, Water pollution effects.

Placer gold mining, which extracts gold from buried or exposed alluvia, is often conducted on or near streams. Such mining has the potential to adversely affect water quality. Other heavy metals associated with the gold (such as arsenic, cadmium, lead, zinc, and copper) may be freed to enter streams. Mercury may also enter streams if miners are using it to recover fine particles of gold. These heavy metals are toxic and thus may be harmful to the aquatic life of the streams receiving effluent or runoff from placer mines. In 1982 two streams were sampled intensively - one heavily mined and one unmined - for total recoverable arsenic, mercury, lead, zinc, and copper. Only mercury was not significantly higher in concentration in the mined streams. In 1983 two stream pairs were sampled three times, and 10 other sites at least once, for total and dissolved arsenic, cadmium, mercury, lead, zinc, and copper. Mercury and cadmium were not significantly elevated in mined streams, but the concentrations of total arsenic, lead, zinc, and copper, and dissolved arsenic and zinc were significantly higher in streams below active placer mining sites than in these that were not being mined or those that had never been mined. Additonally, total arsenic, lead, zinc, and copper and dissolved arsenic and copper became elevated after mining began in 1983 on a previously unmined stream. (Author's abstract)
W86-00786

DISTRIBUTION AND PERSISTENCE OF AMINOCARB IN STREAM WATER, SEDIMENT AND FISH AFTER APPLICATION OF THREE MATACIL FORMULATIONS,
Forest Pest Management Inst., Sault Sainte Marie (Ontario).
For primary bibliographic entry see Field 5B.
W86-00811

RELATIONSHIPS BETWEEN SURFACE SEDIMENT DIATOM ASSEMBLAGES AND LAKEWATER CHARACTERISTICS IN ADIRONDACK LAKES,
Indiana Univ. at Bloomington. Dept. of Biology.
For primary bibliographic entry see Field 2H.
W86-00829

VIRAL POLLUTION OF THE MARINE ENVIRONMENT,
Minnesota Univ., St. Paul. Coll. of Veterinary Medicine.
For primary bibliographic entry see Field 5B.
W86-00851

ASBESTOS IN DRINKING WATER
Department of National Health and Welfare, Ottawa (Ontario). Health Protection Branch.
For primary bibliographic entry see Field 5B.
W86-00853

EFFECT OF ACID RAIN ON SOILS,
Iowa State Univ., Ames. Dept. of Agronomy.
M. A. Tabatabai.
CRC Critical Reviews in Environmental Control, Vol. 15, No. 1, p 65-110. 8 Fig, 11 Tab, 166 Ref.

Descriptors: *Acid rain, *Soil chemistry, *Water pollution effects, *Acidity, Source of pollutants, Nutrients, Nitrogen, Sulfur, Ammonium, Fertilizers.

Soil reaction and pH, factors affecting soil formation, sources and forms of acidity in soils, the effect

of soil pH on soil chemical and biochemical properties, the sources, forms and importance of acidity in precipitation, and deposition of macro- and micronutrients on soils in precipitation are reviewed. Soil formation is an acidifying process that involves dynamic chemical and biochemical equilibria. The sources of acidity in soils include H2CO3 formed from high CO2 concentrations in the soil atmosphere produced from root and microbial respiration, acidity produced in mineralization of organic N and S, N fixation by leguminous plants, NH4(+)-forming fertilizers, organic acids produced from crop residue and litter decomposition, and, in addition, precipitation. Additions of acidity in precipitation to soils are insignificant in comparison with the acidity produced in natural processes and by agricultural soil amendments. Information obtained to date indicates that acid rain has not adversely affected soils. Dry deposition and acid dew and fog formation near point source pollution sites, however, may cause greater acidification of soils and therefore deserve investigation. Addition to soils of trace elements and heavy metals by acid precipitation is not significant relative to the amounts present in soils and added in fertilizers, animal manure, and municipal sludges. Significant acidification of soils may lead to greater mobility of these elements in the environment. The pronounced intrinsic buffering capacity provided by soil minerals and organic matter tends to minimize changes in pH of soils receiving acid precipitation. The amounts of N and S added by precipitation are beneficial to agricultural, forested, and unmanaged soils. The amounts of other macro- and micronutrients added to soils in precipitation are insignificant compared with those present in soil systems. (Rochester-IVI)
W86-00858

EFFECT OF FLOODING OF SOIL ON GROWTH AND SUBSEQUENT RESPONSES OF TAXODIUM DISTICHUM SEEDLINGS TO SO2,
Wisconsin Univ.-Madison. Dept. of Forestry.
J. Shanklin, and T. T. Kozlowski.
Environmental Pollution (Series A), Vol. 38, No. 3, p 199-212, 1985. 3 Tab, 38 Ref.

Descriptors: *Flooding, *Soil water, *Plant growth, *Sulfur dioxide, *Trees, Plant physiology, Water pollution effects, Plant tissues, Acid rain.

Unflooded and flooded, twelve-week-old Taxodium distichum (L.) Rich seedlings were grown for eight weeks in a growth chamber and then exposed to 0, 0.5, 1.0 or 1.5 micro-l/l SO2 for 48h. The seedlings were grown in the glasshouse for an additional six weeks. Flooding with stagnant water decreased the rate of height growth, needle initiation and expansion, and dry weight increment of leaves and roots, but not stems. Flooding of unfumigated seedlings for an additional six weeks also significantly reduced dry weight increment of stems. The greater reduction in root growth over shoot growth in flooded seedlings will tend to create leaf water deficits and predispose seedlings to drought injury when the flood waters recede. Exposure to SO2 at 1.0 micro-l/l or higher concentration reduced growth in both previously unflooded or flooded seedlings, but growth was reduced more in the unflooded seedlings which absorbed more S. Growth of seedlings was reduced more by flooding than by SO2. A significant flooding-SO2 interaction on dry weight increment of leaves, but not roots or stems, was shown. The effects of flooding and SO2 on growth differed when based on analysis of dry weight increment or relative growth rates of seedlings. Greater standardization of methods of determining plant responses to pollution is needed. (Author's abstract)
W86-00861

EFFECTS OF MUNICIPAL SLUDGE AND FERTILIZER ON HEAVY METAL ACCUMULATION IN EARTHWORMS,
Miami Univ., Oxford, OH. Dept. of Zoology.
E. A. Kruse, and G. W. Barrett.
Environmental Pollution (Series A), Vol. 38, No. 3, p 235-244, 1985. 3 Tab, 29 Ref. EPA grant R-807370-01.

Descriptors: *Land disposal, *Heavy metals, *Earthworms, *Environmental effects, *Fertilizer, *Sludge disposal, Cadmium, Copper, Lead, Zinc, Metals, Bioaccumulation.

Comparisons were made of heavy metal concentrations of cadmium, copper, lead, and zinc in Lumbricus rubellus collected from a three-year-old field community in which replicate plots were treated five times annually for four years with either fertilizer, sewage sludge, or left untreated as controls. Concentrations of all four metals were significantly higher (P < or = 0.05) in the soil from sludge-treated plots than from fertilizer or control plots. Cadmium concentration was approximately nine times greater in earthworms from sludge plots than in those from control or fertilizer plots. Although amounts of copper (mean = 20.7 micro-g/g) and lead (8.75 micro-g/g) were also significantly higher in earthworm tissue from sludge-amended communities as compared to fertilizer or control treatments, concentration factors were relatively low, suggesting possible biological regulation of these metals. No significant differences were found between treatments for zinc concentrations in earthworm tissue. Lumbricus rubellus appears to be an ideal indicator species for investigating rates of heavy metal uptake within terrestrial ecosystems. (Author's abstract)
W86-00862

ENVIRONMENTAL IMPACT OF PAPER MILL WASTE DISCHARGES TO THE SWALE,
Southern Water Authority, Chatham (England). Kent Div.
R. A. Dines, and J. R. Wharfe.
Environmental Pollution (Series A), Vol. 38, No. 3, p 245-260, 1985. 7 Fig, 1 Tab, 18 Ref.

Descriptors: *Pulp and paper industry, *Industrial wastewater, *Swale, *England, *Water pollution effects, Wastewater pollution, Sediments, Suspended solids, Benthos, Anaerobic conditions.

The Swale is a tidal channel on the southeast coast of England, which has international significance as a wildlife refuge and, until the 1930s, supported a major oyster fishery. Disposal of paper mill wastes over many years has now degraded the marine environment to such an extent that pollution abatement measures are imperative. This study was carried out in order to predict the effects of such measures and to assess the current impact of the discharges. Surveys of the soft sediment fauna, together with sediment redox profiles, organic carbon and cellulose content, showed that the fauna is impoverished with the most severe effects in Milton Creek, which joins the Swale close to the major waste discharge. In the main channel the blanketing effect of a high suspended solid load is considered to be responsible, and this should respond rapidly to improvements in effluent quality. In the creek, however, the sediments are highly reduced and recovery would probably be very slow. (Author's abstract)
W86-00863

QUANTITATIVE STRUCTURE-TOXICITY RELATIONSHIPS WITH OSMOTICALLY STRESSED ARTEMIA SALINA NAUPLII,
California State Univ., Hayward. Dept. of Biological Sciences.
G. D. Foster, and R. E. Tullis.
Environmental Pollution (Series A), Vol. 38, No. 3, p 273-281, 1985. 2 Tab, 13 Ref.

Descriptors: *Toxicity, *Osmotic pressure, *Shrimp, *Partition coefficients, Water pollution effects, Bioassays, Salinity, Organic compounds.

Aquatic animals subjected to osmotic stress may show an increased toxicity response to water contaminants. Artemia salina cysts were hatched and raised in 50% or 25% artificial seawater at 19 C and the resulting Stage II nauplii were exposed to various organic chemicals to determine immobilization concentrations (IC sub 50 :24h). Simple linear regressions were used to compare the 50% immobilization concentration (IC sub 50) values at both salinities to n-octanol water partition coefficients. The fundamental equation is described by log 1/IC sub 50 = a + b x log P. Positive linear regressions were observed at both salinities indicating a nonspecific-type toxicity. The regression and correlation parameters were not significantly different between the two relationships. As the salinity was decreased, however, the intercepts increased and the slopes decreased in a slight but consistent fashion. The present quantitative model appears to be relatively insensitive to changes in the toxicity of organic chemicals to osmotically stressed A. salina nauplii. (Author's abstract)
W86-00864

EFFECT OF SAFE CONCENTRATIONS OF SOME PESTICIDES ON OVARIAN RECRUDESCENCE IN THE FRESHWATER MURREL, CHANNA PUNCTATUS (BL.): A QUANTITATIVE STUDY,
Punjab Agricultural Univ., Ludhiana (India). Dept. of Zoology.
K. Mani, and P. K. Saxena.
Ecotoxicology and Environmental Safety, Vol. 9, No. 3, p 241-249, June, 1985. 3 Tab, 38 Ref.

Descriptors: *Carbofuran, *Fenitrothion, *Pesticide toxicity, *Reproduction, *Murrels, Fish, Toxicity, Spawning, Organophosphorus pesticides, Carbamate pesticides.

The effects of safe concentrations of carbofuran 3% G (5 ppm) and fenitrothion 30% E.C. (1.5 ppm) on ovarian recrudescence of Channa punctatus during the maturing, prespawning, and spawning phases (mid-April through mid-August) of the annual reproduction cycle were studied. The results reveal that, compared to carbofuran treatment, fenitrothion was more effective not only in lowering ovarian weights, but also in retarding the growth of previtellogenic (stage I) oocytes into vitellogenic (stage II) and yolky (stage III) oocytes. In addition, more previtellogenic and vitellogenic oocytes underwent atresia in fenitrothion-treated fish and only atretic oocytes were observed in the ovaries of these fish after 120 days of exposure. The fenitrothion treatment also caused a significant decline in the diameter of stage III oocytes, and in the number of nucleoli in stage I oocytes. (Author's abstract)
W86-00872

FISH PHYSIOLOGY AND METAL POLLUTION: RESULTS AND EXPERIENCES FROM LABORATORY AND FIELD STUDIES,
National Swedish Environment Protection Board, Nykoeping. Brackish Water Toxicology Lab.
A. Larsson, C. Haux, and M. L. Sjobeck.
Ecotoxicology and Environmental Safety, Vol. 9, No. 3, p 250-281, June, 1985. 5 Fig, 2 Tab, 123 Ref.

Descriptors: *Fish physiology, *Water pollution effects, *Metals, Toxicity, Seasonal variation, Enzymes, Metabolism, Sweden.

Many physiological methods can be very useful for revealing adverse toxic effects of pollutants on fish at low exposure levels. Such diagnostic tests can also be applied to fish in a complex field situation. Physiological methods were applied to feral fish living in metal-polluted waters. The fish used were perch, whitefish and fourhorn sculpin from polluted and unpolluted lakes, rivers and coastal waters of Sweden. The results and experiences from the field application show that certain clinical methods may be very useful in detecting and diagnosing sublethal disturbances in natural fish populations in polluted areas. There is a good agreement between metal-induced physiological effects detected in fish exposed under natural field conditions and those found in laboratory experiments. Variations due to sex and body size, selection of sampling locations, and the season are essential factors which must, however, be taken into account in physiological field studies. The aberrant values for several physiological parameters in fish from metal-contaminated waters indicate that the metal pollution has a profound influence on important physiological functions, such as the immune defense, ion balance and glucose homeostasis. Among the tested physiological variables, the erythrocyte delta-aminolevulinic acid dehydratase activity and the white blood

cells seem to be the most promising indicators of metal pollution. (Moore-IVI)
W86-00873

SHORT-TERM TEST FOR PREDICTING THE POTENTIAL OF XENOBIOTICS TO IMPAIR REPRODUCTIVE SUCCESS IN FISH,
Swedish Environmental Research Inst., Stockholm.
For primary bibliographic entry see Field 5A.
W86-00874

JOINT TOXICITY OF MIXTURES OF GROUPS OF ORGANIC AQUATIC POLLUTANTS TO THE GUPPY (POECILIA RETICULATA),
Utrecht Rijksuniversiteit (Netherlands). Dept. of Veterinary Pharmacology, Pharmacy and Toxicology.
J. Hermens, P. Leeuwangh, and A. Musch.
Ecotoxicology and Environmental Safety, Vol. 9, No. 3, p 321-326, June, 1985. 5 Tab, 10 Ref.

Descriptors: *Water pollution effects, *Toxicity, *Organic compounds, *Guppies, Chloroanilines, Chlorophenols, Halogenated hydrocarbons, Fish.

In this study acute lethal concentrations (LC50) to the guppy (Poecilia reticulata) were determined for mixtures of 4 groups of aquatic pollutants. The groups were composed of 11 nonreactive, nonionized organic chemicals, 11 chloroanilines, 11 chlorophenols, and 9 reactive organic halides. Earlier studies indicated that the joint toxicity within each of these groups was concentration additive, probably because of a similar mode of action. The joint toxicity of combinations of one representative from each group showed a high variance, but generally tended to be partially additive to concentration additive. This high variance is probably caused by the low number of compounds in these mixtures. Experiments with mixtures of whole groups gave more accurate results. The toxicity of a mixture of the first three groups, containing 33 well-known aquatic pollutants, was almost completely concentration additive. Concentrations of 0.04 of the individual LC50 values contributed to the toxicity of this mixture. (Author's abstract)
W86-00876

EXAMPLE OF INTERACTION BETWEEN ENVIRONMENTAL POLLUTANTS: MODIFICATION OF THIRAM TOXICITY TO FRESHWATER ORGANISMS BY NITRITES OR NITRATES IN RELATION TO NITROSAMINE SYNTHESIS,
Rouen Univ., Mont-Saint-Aignan (France). Lab. de Toxicologie.
J. M. Jouany, R. Truhaut, P. Vasseur, D. Klein, and J. F. Ferard.
Ecotoxicology and Environmental Safety, Vol. 9, No. 3, p 327-338, June, 1985. 8 Fig, 3 Tab, 16 Ref. Direction des Recherches, Etudes et Techniques contract DRET 78/299.

Descriptors: *Thiram, *Toxicity, *Nitrites, *Nitrates, *Nitrosamines, Water pollution effects, Fungicides, Carbamates, Chlorella, Daphnia, Carp, Brachydanio, Food chains, Fate of pollutants, Carcinogens, Algae.

Thiram, a dithiocarbamate fungicide, is known to evolve to dimethylnitrosamine (DMNA) when associated with nitrites. Conditions of appearance of that carcinogenic compound have been studied in short-term experiments by association of the fungicide, nitrates or nitrites, and species representative of freshwater biota. DMNA has been estimated by GLC equipped with a specific detector. Chlorella vulgaris can rapidly produce nitrites from nitrates and DMNA is obtained in presence of thiram. Daphnia magna can also synthesize DMNA but nitrites have to be added to the medium. Increased toxicity of thiram is observed. The same results are obtained on Cyprinus carpio and for a part on Brachydanio rerio. When the species are associated in a 15-day experimental food chain, and intoxicated algae feed the two other levels, no significant transfer is observed. Nevertheless, some DMNA hazard may exist for particular species exposed to thiram associated with nitrites or even nitrates if algae are present. (Author's abstract)
W86-00877

METHYL PARATHION (O-O-DIMETHYL O-4-NITROPHENYL THIOPHOSPHATE) EFFECTS ON WHOLE-BODY AND TISSUE RESPIRATION IN THE TELEOST, TILAPIA MOSSAMBICA (PETERS),
Sri Venkateswara Univ., Tirupati (India). Dept. of Zoology.
K. S. Prasada Rao, I. K. Ahammad Sahib, and K. V. Ramana Rao.
Ecotoxicology and Environmental Safety, Vol. 9, No. 3, P 339-345, June, 1985. 3 Tab, 16 Ref. UGC grant F-30-49/77.

Descriptors: *Methyl parathion, *Respiration, *Tilapia, *Toxicity, Water pollution effects, Fish, Organophosphorus pesticides, Oxygen consumption, Enzymes.

The respiratory parameters of an animal are important physiological processes for assessing toxic stress, because they are valuable indicators of function of all vital life-sustaining processes. Respiratory parameters of the freshwater teleost, Tilapia mossambica, exposed to the organophosphorus pesticide methyl parathion were studied. The fish were exposed at 0.09 ppm methyl parathion, which represents a sublethal level of about one-third of the 48 hr LC50 value. The rate of oxygen consumption by whole fish and selected tissues decreased during a 48-hr time-course study. The activities of the respiratory enzymes succinate dehydrogenase, malate dehydrogenase, and cytochrome-c oxidase also decreased considerably under methyl parathion exposure in muscle, gill, liver and brain tissues. Methyl parathion, even at sublethal concentrations, has a profound effect on the oxidative metabolism of the fish, possibly due to its influence on the respiratory center of the brain. (Moore-IVI)
W86-00878

STUDIES ON THE SEQUENCE OF 2,6-DIISOPROPYLNAPHTHALENE METABOLITE FORMATION USING CARP HEPATOCYTE,
Tokyo Univ. of Fisheries (Japan). Dept. of Marine Environmental Science and Technology.
H. Kojima, M. Tanaka, and T. Yoshida.
Ecotoxicology and Environmental Safety, Vol. 9, No. 3, p 364-368, June, 1985. 4 Fig, 10 Ref.

Descriptors: *Carp, *Diisopropylnaphthalene, *Metabolism, *Hepatocytes, Water pollution effects, Toxicity, Naphthlalenes, Fish.

The effects of chemical substances on aquatic organisms are of great concern in ecotoxicological study. Studies on xenobiotic metabolism in fish are of importance. Xenobiotics are metabolized mainly in hepatic microsomes and catalyzed by the cytochrome P-450-mediated mixed-function oxidase system in mammals as well as in fish. Metabolism of 2,6-diisopropylnaphthalene (2,6-DIPN) was studied in freshly isolated carp hepatocytes. The viability of the isolated hepatocytes was 93%. 2,6-DIPN was metabolized to form several oxidized products such as the tertiary hydroxy, the primary hydroxy, and two types of dihydroxy DIPN. The formation of 2,6-DIPN metabolites in the carp hepatocyte system might occur in the following order: tertiary monohydroxyl, primary monohydroxyl, tertiary-tertiary dihydroxyl, and finally primary-tertiary dihydroxyl metabolite at the isopropyl group. (Moore-IVI)
W86-00879

EFFECTS OF SOME DIVALENT METALS ON CARDIAC AND BRANCHIAL CA2+-ATPASE IN FRESHWATER FISH SACCOBRANCHUS FOSSILIS,
Industrial Toxicology Research Centre, Lucknow (India).
S. K. Bansal, R. C. Murthy, and S. V. Chandra.
Ecotoxicology and Environmental Safety, Vol. 9, No. 3, p 373-377, June, 1985. 3 Tab, 12 Ref.

Descriptors: *Metals, *Toxicity, *Adenosine triphosphatase, *Calcium, *Saccobranchus, Enzymes, Magnesium, Mercury, Lead, Manganese, Cadmium, Fish, Calcium pump.

The heart and gill of a freshwater fish Saccobranchus fossilis have been shown to contain a Ca(2+)-activated ATPase involved in Ca(2+) transport. Enzyme showed optimal activity at 3 mM Ca(2+) and 3 mM ATP for gills and at 3 mM Ca(2+) and 1 mM ATP for heart. Mg(2+) was equally effective in stimulating enzyme activity but was not essential for hydrolysis. Maximum activity was found in heart ventricular muscles as compared to gills. Among all the metals tested Hg(2+) was the most toxic (IC50, 0.75 and 0.85 micro-M for heart and gill, respectively) followed by Pb(2+), Mn(2+), and Cd(2+). The inhibition was concentration dependent and reached almost 100% with each metal at the highest concentration. Stimulation of enzyme activity was observed at lower concentrations of Mn(2+) and Cd(2+) but not with Pb(2+) and Hg(2+). Stimulation was more pronounced with Mn(2+) than with Cd(2+) in both heart and gills. The results indicated that the inhibitory effect of these metals might be through the Ca(2+)-ATPase which is a manifestation of the calcium pump in various tissues. (Author's abstract)
W86-00880

SUBLETHAL EFFECTS OF SIMULATED PULP MILL EFFLUENTS ON THE RESPIRATION AND ENERGY METABOLISM OF RAINBOW TROUT (SALMO GAIRDNERI),
Helsinki Univ. (Finland). Dept. of Zoology.
A. Oikari, M. Nikinmaa, S. Lindgren, and B.-E. Lonn.
Ecotoxicology and Environmental Safety, Vol. 9, No. 3, p 378-384, June, 1985. 3 Tab, 19 Ref.

Descriptors: *Pulp wastes, *Trout, *Water pollution effects, *Respiration, *Metabolism, Kraft mills, Effluents, Chlorophenols, Sulfate soap, Toxicity.

Rainbow trout were exposed to 0.08 x 96-hr LC50 concentration of simulated unbleached (KME-Sa) and bleached (KME-Sa + CP) kraft pulp mill effluents. A sulfate soap preparation (Sa) with and without added chlorophenols (CP) was used as the toxicant mixture. The lipid content of white muscle increased in both test groups, and its protein content decreased in the KME-Sa-treated group. The ammonia excretion rate also decreased in both test groups. These results show that there was a shift from protein to lipid metabolism. On the other hand, apart from a slight hypoglycemia, only minor changes were observed in the carbohydrate metabolism. The overall effects on blood respiratory properties were functionally insignificant. However, the effects of kraft mill effluent with and without chlorophenols were qualitatively dissimilar in several respects. (Author's abstract)
W86-00881

DICHLORVOS INTOXICATION IN A FRESHWATER PRAWN, MACROBRACHIUM LAMARREI (H. MILNE EDWARDS),
D.A.V. Coll., Muzaffarnagar (India). Pollution Relevant Research Lab.
Omkar, and G. S. Shukla.
Ecotoxicology and Environmental Safety, Vol. 9, No. 3, p 392-396, June, 1985. 1 Tab, 29 Ref.

Descriptors: *Prawn, *Toxicity, *Dichlorvos, Pesticide toxicity, Crustaceans, Enzyme inhibition, Physiology, Metabolism, Water pollution effects.

Dichlorvos is an extensively used organophosphorous pesticide which has been shown to be very toxic to crustaceans. The freshwater prawn Macrobrachium lamarrei was exposed to dichlorvos at 0.31 and 0.62 mg/l (40 and 80% of the 96-hr LC50) for 24, 48, 72 and 96 hr. Inhibition in acetylcholinesterase and alkaline phosphatase activities with an elevation in acid phosphatase activity were recorded in M. lamarrei after sublethal dichlorvos exposure under static conditions. It is inferred that exposure to dichlorvos creates a wide-spread disturbance in the physiology of prawns which ulti-

mately leads to the death of the organisms. (Moore-IVI)
W86-00882

INFLUENCE OF DEVELOPMENT OF THE RIVER WIDAWKA ON THE EPHEMEROPTERA FAUNA (INFLUENCE DES AMENAGEMENTS DE LA RIVIERE WIDAWKA SUR LA FAUNE DES EPHEMEROPTERES),
Lodz Univ. (Poland). Inst. of Environmental Biology.
T. Jazdzewska.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, Part 4, p 2063-68, March 1985. 3 Fig, 1 Tab, 14 Ref.

Descriptors: *Aquatic insects, *Mayflies, *Environmental effects, *Widawka, *Poland, Mining, Stream stabilization, Temperature effects, Stream flow, Linings, Species diversity, Substrates.

The discovery of lignite deposits in Central Poland led to the foundation of the Belchatow Industrial Center (BIC). The construction of a deep shaft for mine drainage began in 1973, and in 1977 the removal of earth above the deposits commenced. The development of the BIC has led to unfavorable changes in the natural environment in the area, most of which lies within the Widawka river basin. The influence of the BIC on the Ephemeroptera of the Widawka was studied in segments of the river above and below the area of influence, and in an area where the river runs through a concrete bed. Changes in the flow and thermal regime of the river were observed after 1975. There was a notable decrease in the number of species after the introduction of the concrete bed; there were 23 species before and 9 species after the change in the bed. Modification to the substrate of the river exerts an influence on the fauna comparable to that of organic pollution. (Moore-IVI)
W86-00914

PATTERNS OF MACROINVERTEBRATE DISTRIBUTION IN THE LLOBREGAT RIVER BASIN (NE SPAIN),
Barcelona Univ. (Spain). Dept. de Ecologia.
For primary bibliographic entry see Field 2H.
W86-00917

5D. Waste Treatment Processes

EFFECT OF TEMPERATURE ON OXYGEN TRANSFER RATE IN WASTEWATER TREATMENT,
Cleveland State Univ., OH. Dept. of Civil Engineering.
Y. Dong, and Y.-T. Hung.
International Journal of Environmental Studies, Vol. 24, No. 2, p 125-135, 1985. 3 Fig, 7 Tab, 1 Ref.

Descriptors: *Wastewater treatment, *Oxygen transfer rate, *Temperature effects, Aeration, Industrial wastewaters, Domestic wastes, Organic compounds.

A comparison was made of percent error between empirical temperature coefficients and theoretical temperature coefficients. The applicable temperature ranges for empirical temperature coefficients were also discussed. In computing the oxygen transfer efficiency of surface aerators for wastewater, the combined effect of oxygen deficit and wastewater viscosity needs to be considered. The lower the wastewater temperature, the lower the oxygen transfer efficiency of surface aerators for wastewater, since viscosity has a dominating effect on oxygen transfer rate in wastewater at lower temperatures. It is recommended that the temperature, which is the average maximum temperature expected in the aeration tank mixed liquors, should be used in the calculation of oxygenation capacity and in the selection of surface aerators for wastewater treatment. (Baker-IVI)
W86-00658

CONTAMINANT DEGRADATION IN WATER,
North Carolina State Univ. at Raleigh. Dept. of Chemical Engineering.
For primary bibliographic entry see Field 5F.
W86-00660

NEW CONCEPTUAL FORMULATION FOR PREDICTING FILTER PERFORMANCE,
Indian Inst. of Tech., Kanpur. Dept. of Civil Engineering.
V. Tare, and C. Venkobachar.
Environmental Science and Technology, Vol. 19, No. 6, p 497-499, June, 1985. 3 Fig, 8 Tab.

Descriptors: *Filtration, *Head loss, *Removal efficiency, Water treatment, Wastewater treatment, Filters, Unit Bed Element, Porous media, Mathematical equations.

This paper describes the development of a new conceptual model for predicting head loss buildup and removal efficiency during filtration by packed beds based on the postulate that some retained particles can act as collectors and thereby improve the filtration efficiency. The concept of Unit Bed Element (UBE) and of the unit collector is used for the quantitative description of the various processes of interest which occur in the porous medium. The filtration efficiency is described by a set of three interdependent equations for monosized particles in suspension assuming the porosity of the bed to remain constant as filtration progresses. The first equation computes the single collector removal efficiency related to clean grain efficiency and retained particles acting as collectors. The second equation estimates the number of retained particles acting as collectors as a function of depth, time, and local particle concentration in suspension. The third equation predicts suspended particle concentration with time over the entire filter depth. The head loss buildup is predicted by modifying the classical head loss equation for clean beds incorporating change in the surface area to volume ratio of the filter grains. The model is calibrated and verified with a set of laboratory data obtained from literature under varying conditions of operating and system variables. The results show strong agreement between model predictions and experimental observations as indicated by low values of standard error of estimate associated with coefficient of correlation values approaching unity. (Author's abstract)
W86-00661

REMOVAL OF ARSENIC FROM GEOTHERMAL FLUIDS BY ADSORPTIVE BUBBLE FLOTATION WITH COLLOIDAL FERRIC HYDROXIDE,
Hawaii Inst. of Geophysics, Honolulu.
E. H. De Carlo, and D. M. Thomas.
Environmental Science and Technology, Vol. 19, No. 6, p 538-544, June, 1985. 7 Fig, 1 Tab, 30 Ref.
DOE contract DE-FG03-81ER10250M003.

Descriptors: *Arsenic compounds, *Adsorptive bubble flotation, *Geothermal fluids, Wastewater treatment, Geothermal power, Ferric hydroxide, Hawaii Geothermal Project.

A method is described for the separation of arsenic species from high ionic strength geothermal fluids produced by the Hawaii Geothermal Project well-A (HGP-A). The oxyanions of As(III) and As(V), which are present at a concentration level of 100 +/- 10 micro-g/L total arsenic, are concentrated by adsorbing colloid flotation (ACF) onto, or precipitate flotation with, colloidal ferric hydroxide, depending on the pH. The anionic surfactant sodium lauryl sulfate (SLS) and the cationic surfactant lauryl-ammonium chloride (LA) are used as collectors below and above the isoelectric point (IEP), respectively. Efficiency of recovery of the trivalent arsenic oxyanion is pH and method dependent whereas that of the pentavalent arsenic is independent of the flotation method employed. Quantitative removal of total arsenic in solution is achieved above pH 6.5 by coprecipitation with ferric hydroxide; LA is used as the collector, and the air flow rate is 17 +/- 3 mL/min. The zeta potentials of flocs are greatly affected by a variety of species in the geothermal fluids and the source of iron. (Author's abstract)
W86-00662

BINDING OF CADMIUM, COPPER, AND LEAD IONS BY MODIFIED CELLULOSIC MATERIALS,
Benin Univ., Benin City (Nigeria). Dept. of Chemistry.
F. E. Okieimen, D. E. Ogbeifun, G. N. Nwala, and C. A. Kumsah.
Bulletin of Environmental Contamination and Toxicology, Vol. 34, No. 6, p 866-870, June, 1985. 1 Fig, 2 Tab, 4 Ref.

Descriptors: *Copper chloride, *Cadmium sulfate, *Lead nitrate, *Groundnut, *Adsorption, *EDTA, *Wastewater treatment, Metals, Heavy metals, Cellulose, Water treatment.

Groundnut (Arachis hypogaea) husk modified by complexation with ethylene-diaminetetraacetic acid (EDTA) demonstrated enhanced capacity to bind Pb(NO3)2, CuCl2, and CdSO4 from aqueous solution, indicating a potential use for modified groundnut husks in removal of heavy metal ions from wastewaters. In studies with Cu(II) ions, it was shown that the percentage of metal ion adsorbed initially increased with contact time, but stabilized at about 20 min, regardless of concentration (range: 200-500 ppm). The percentage of ion removed decreased as concentration increased, ranging from over 70% at 200 ppm to about 30% at 500 ppm. The concentration amount of metal ion adsorbed per gram of groundnut husks, however, increased as initial concentration of metal ions increased. In flow-through column experiments, the amount of metal ions removed from solution was Pb(II) > Cu(II) > or = Cd(II). For example, a Pb(NO3)2 initial concentration of 500 mg/l was reduced to 186 mg/l by passage through the column, an initial CuCl2 of 500 mg/l was reduced to 202 mg/l, and an initial CdSO4 concentration of 500 mg/l was reduced to 322 mg/l/. Proportionally greater reductions were obtained for lower initial concentrations of all three salts. In the equilibrium experiments, the amount of metal ion adsorbed was lower when groundnuts without EDTA were used. (Rochester-IVI)
W86-00692

SIMULATED SOLUTE MOVEMENT IN WASTEWATER-PONDED SOIL,
Florida Univ., Gainesville. Dept. of Plant Pathology.
R. S. Mansell, P. J. McKenna, and M. E. Hall.
Soil Science Society of America Journal, Vol. 49, No. 3, p 541-546, May-June, 1985. 8 Fig, 14 Ref.

Descriptors: *Solute transport, *Wastewater renovation, *Ponding, *Simulation, Land disposal, Rapid infiltration, Sorption, Wastewater treatment, Phosphorus, Mathematical models.

A finite-difference numerical model was used to predict sorption and transport of P in a rapid infiltration land system for renovating urban wastewater. The soil was assumed to be water-saturated and two-dimensional steady flow was assumed to occur from a 2-m wide ponded recharge zone toward a subsurface collection drain located at a lateral distance of 3 m. The rectangular area of interest was bounded underneath by an impermeable layer at the 1-m depth and was limited to a lateral length of 5 m. Phosphorus sorption in the soil was assumed to occur as two consecutive kinetic reactions - rapid physical adsorption followed by slower chemisorption. Transient movement and sorption of P in the soil was predicted with the model for a step-function increase in P concentration in the applied wastewater. Results predicted by the model were used to construct plots of concentration isopleths of P in solution and sorbed phases in the soil. Sorption reactions removed P from the flowing solutions in the soil directly beneath the recharge area, resulting in a retardation of the concentration of P appearing in the drainage water. Simulated breakthrough curves for the concentration of a nonreactive solute in the drainage effluent compared well to those obtained with an approximate analytical

model from published literature. (Author's abstract)
W86-00699

ENCLOSED VESSEL COMPOSTING BEGINS AT CAPE MAY COUNTY,
Cape May County (NJ) Municipal Utilities Authority.
For primary bibliographic entry see Field 5E.
W86-00713

PROTECTING WATER QUALITY IN THE MIDWEST: IMPACT ON TIMBER HARVESTING COSTS,
Minnesota Univ., St. Paul. Dept. of Forest Resources.
P. V. Ellefson, and P. D. Miles.
Northern Journal of Applied Forestry, No. 2, p 57-61, June, 1985. 1 Fig, 2 Tab, 16 Ref.

Descriptors: *Forest management, *Water quality control, *Costs, Cutting management, Water bars, Broad-based dips, Buffer strips, Culverts, Skid trails, Landings, Roads.

Practices designed to perfect water quality from forested areas have very real economic consequences for timber harvesting. The magnitude of such impacts varies with the practice in question and the market and financial conditions faced by the timber harvester. Costs were evaluated for six forest practices designed to prevent degradation of water quality from 18 timber harvesting operations in the Midwest. The six practices are water bars, broad-based dips, buffer strips, culverts, skid trail and landing design, and seeding of roads and landings. Net revenue reductions ranged from 1.2% for redesigning landing and skid trail locations to 26.4% for meeting buffer strip requirements. Nine operations were profitable with application of all six practices. Excluding the four harvesting operations having less than zero net revenue using conventional practices, 14 of the sales have a positive net return when culverts are added and landings and skid trails are redesigned. Thirteen sales maintain a positive net return with the addition of such practices plus the installation of water bars. (Moore-IVI)
W86-00720

HEAVY METAL CONCENTRATIONS IN MUNICIPAL WASTEWATER TREATMENT PLANT SLUDGE,
O'Brien and Gere Engineers, Inc., Syracuse, NY.
For primary bibliographic entry see Field 5B.
W86-00726

REMOVAL OF SOLUBLE SUBSTRATES IN FIXED FILMS,
Krouger (I.) A/S, Soeborg (Denmark).
J. la C. Jansen, and P. Harremoes.
Water Science and Technology, Vol. 17, No. 2/3, p 1-14, 1985. 12 Fig, 4 Tab, 29 Ref.

Descriptors: *Fixed film reactors, *Biological wastewater treatment, Substrates, Biofilms, Bacteria, Denitrification, Oxidation, Methanol, Acetic acid, Glucose, Mathematical equations, Diffusion, Kinetics, Oxygen.

Common to all types of fixed film reactors are the processes within the fixed film. The substrates may be brought to the surface of the bacterial layer in many different ways, but inside the biofilm the substrates have to be transported, in soluble form, to the bacteria where the reaction takes place, and the reaction products have to be transported out again. Experiments were performed with denitrification and with oxidation of methanol, acetic acid and glucose in a laboratory fixed film reactor to demonstate the validity of equations for removal of soluble substrates. A basic concept involving diffusional resistance to the bulk removal rate of soluble substrates in fixed films was verified. The experiments confirm the predictions of the half order reaction model, taking diffusion of the substrates and zero order intrinsic reaction rate of the bacteria as the dominating processes in the film. The experiments enable calculation of the kinetic parameters: diffusion coefficients, intrinsic reaction rates and half order rate constants for nitrate, methanol, acetic acid, glucose and oxygen within fixed films. Oxygen may be limiting for the surface removal rate of aerobic degradation of organics in fixed films due to the low solubility of oxygen in water and due to diffusional resistance to the oxygen transportation in the film. (Moore-IVI)
W86-00734

INFLUENCE OF PARTICULATE ORGANICS ON THE REMOVAL OF DISSOLVED ORGANICS IN FIXED-FILM BIOLOGICAL REACTORS,
Lund Univ. (Sweden). Dept. of Environmental Engineering/
E. Sarner, and S. Marklund.
Water Science and Technology, Vol. 17, No. 2/3, p 15-26, 1985. 3 Fig, 2 Tab, 16 Ref.

Descriptors: *Fixed film reactors, *Particulate matter, *Organic matter, *Dissolved solids, Biological wastewater treatment, Biofilms, Adsorption, Temperature, Glucose, Starch, Sludge.

Very little is known about the interaction between dissolved and particulate organics in the fixed-film biological process used for wastewater purification, although this process has been used for many decades. The mechanisms for the removal of dissolved and particulate organics differ and it has been found that a large fraction of the organics in most wastewaters exists in particulate form. In these experiments, the influence of particulate organics on the removal of glucose was studied in laboratory-scale fixed-film reactors. The particles used were starch particles and particles obtained from digested sewage sludge. The result of the experiments showed that for high glucose concentrations and high temperatures the removal of glucose was reduced when particles were adsorbed on the biofilm surface. A dramatic reduction was observed when large amounts of particles were adsorbed. This effect has also been observed in a full-scale trickling filter plant and in pilot trickling filters. At low glucose concentrations and low temperatures, however, a slight increase in glucose removal was observed when organic particles were adsorbed on the biofilm surface. (Author's abstract)
W86-00735

EFFECT OF LOAD FLUCTUATIONS ON THE EFFLUENT CONCENTRATION PRODUCED BY FIXED-FILM REACTORS,
Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
B. E. Rittmann.
Water Science and Technology, Vol. 17, No. 2/3, p 45-52, 1985. 8 Tab, 16 Ref.

Descriptors: *Fixed film reactors, *Biological wastewater treatment, *Loading rate, Effluents, Kinetics, Wastewater treatment, Model studies.

Although time-varying loads to biological treatment processes are common, typical kinetic models are based on steady-state loads and conditions. This paper uses nonsteady-state kinetics to demonstrate the impact of load variations on the effluent concentration and load from fixed-bed biofilm reactors. The different responses for reactors having average loads that are high, intermediate, and low are compared. In most cases, time-varying input loading, in comparison with steady input loading, causes an increase in average effluent concentration; however, certain combinations of load variation and reactor type allow better performance than do steady-state loads. (Author's abstract)
W86-00736

EVALUATION OF TEMPERATURE EFFECTS ON TRICKLING FILTER PLANT PERFORMANCE,
Hebrew Univ., Jerusalem (Israel). School of Applied Science and Technology.
A. Adin, E. R. Baumann, and F. D. Warner.
Water Science and Technology, Vol. 17, No. 2/3, p 53-67, 1985. 9 Fig, 4 Tab, 11 Ref.

Descriptors: *Temperature effects, *Trickling filters, *Wastewater treatment, Sedimentation, Biological wastewater treatment, Oxidation, Physical properties, Statistical methods, Biochemical oxygen demand, Suspended solids.

Wastewater temperature has an effect on both sedimentation and secondary biological treatment processes. While trickling filters are mainly affected due to temperature influences on the rate at which biological oxidation occurs, the settling processes are affected mainly through the temperature influence on the physical characteristics of the wastewater. A mathematical-statistical method was developed to help evaluate the temperature effect on BOD and suspended solids residual ratio during and after a trickling filter plant treatment. Mathematical relationships were developed and brought to workable linear forms which are used for statistical examination by the F test method. The data is provided by regular measurements of wastewater quality in a full-scale treatment plant. While settling performance did not respond consistently to temperature changes, the secondary treatment and the overall plant performance provided good correlations with the correct representative temperatures. When a correlation of efficiency due to wastewater temperature has to be made, one should not automatically take the raw sewage temperature for this purpose, but instead select a temperature representative of the process. (Moore-IVI)
W86-00737

ROLE OF AN ANAEROBIC STAGE ON BIOLOGICAL PHOSPHORUS REMOVAL,
Kurita Water Industries Ltd., Yokohama (Japan). Kurita Cental Labs.
T. Fukase, M. Shibata, and Y. Miyaji.
Water Science and Technology, Vol. 17, No. 2/3, p 69-80, 1985. 7 Fig, 5 Tab, 8 Ref.

Descriptors: *Anaerobic digestion, *Phosphorus removal, *Activated sludge process, Biological wastewater treatment, Polyphosphates, Biochemical oxygen demand.

A detailed study was conducted on biological removal of phosphorus by an activated sludge process composed of an anaerobic stage followed by an aerobic stage in order to clarify the role of tha anaerobic stage of the process. Two distinctive sludges, one contained approximately 10% phosphorus, most of which existed in the form of polyphosphates, and other contained 1.9% phosphorus, were obtained by changing BOD concentration of influent and hydraulic detention time of the process. Although the polyphosphate-containing sludge released phosphorus in proportion to the absorbed BOD at anaerobic conditions, the sludge which did not contain polyphosphates also absorbed an equal amount of BOD at the identical rate without any external sources of oxygen. Both sludges accumulated identical levels of poly-beta-hydroxybutyrate within the sludges as the BOD sources were absorbed. These results suggest that the polyphosphate-containing sludges have no advantage over the sludges with no polyphosphates when they uptake BOD in the anaerobic stage. (Author's abstract)
W86-00738

INFLUENCE OF EXTENDED ANAEROBIC RETENTION TIME ON THE PERFORMANCE OF PHOREDOX NUTRIENT REMOVAL PLANTS,
National Inst. for Water Research, Pretoria (South Africa).
A. Gerber, and C. T. Winter.
Water Science and Technology, Vol. 17, No. 2/3, p 81-92, 1985. 2 Fig, 6 Tab, 7 Ref.

Descriptors: *Nitrogen removal, *Phosphorus removal, *Anaerobic retention time, Wastewater treatment, Nitrification, Denitrification, Chemical oxygen demand, Sludge settleability.

Laboratory-scale studies on the performance of three-stage Phoredox nutrient removal systems under nominal anaerobic retention times varying from 6 to 24 h are described. Particular attention is

given to the effect of these extended periods of anaerobiosis on biological phosphate release and uptake, nitrification and denitrification. Increasing the retention time in the abovementioned range had no deleterious effect on nitrification, COD removal, sludge settleability and denitrification but resulted in significantly improved phosphate removals. Up to 15 m/l phosphate (as P) could be removed from settled wastewater at nominal anaerobic retention times of 12 h or more. (Author's abstract)
W86-00739

LOCATION OF PHOSPHORUS IN ACTIVATED SLUDGE AND FUNCTION OF INTRACELLULAR POLYPHOSPHATES IN BIOLOGICAL PHOSPHORUS REMOVAL PROCESS,
Tokyo Univ. (Japan). Dept. of Urban and Sanitary Engineering.
T. Mino, T. Kawakami, and T. Matsuo.
Water Science and Technology, Vol. 17, No. 2/3, p 93-106, 1985. 9 Fig, 11 Ref.

Descriptors: *Phosphorus removal, *Activated sludge process, *Polyphosphates, Biological wastewater treatment, Aerobic conditions, Anaerobic conditions, Microorganisms.

The STS method, a method for the fractionation of intracellular phosphorus, was introduced into the examination of the phosphorus location of activated sludges, and some basic aspects involved in the biological phosphorus removal process were investigated from biological points of view. Although both lowmolecular and highmolecular polyphosphates appeared in the sludges produced in the biological phosphorus removal process, the high phosphorus content of the sludges was caused mainly by the accumulation of lowmolecular polyphosphates and lowmolecular polyphosphates were principally responsible for the release and uptake of phosphorus. The turnover of phosphorus in lowmolecular and highmolecular polyphosphates was investigated by using P-32 labelled orthophosphate as a tracer. The phosphorus turnover in lowmolecular polyphosphates was not observed under both anaerobic and anerobic conditions, while the phosphorus turnover in highmolecular polyphosphates occurred under the aerobic conditions. It was indicated that lowmolecular polyphosphates function as the energy pool under the anaerobic conditions and that highmolecular polyphosphates function as the phosphorus source for the microbial growth. (Author's abstract)
W86-00740

PHOSPHORUS REMOVAL FROM WASTEWATER BY THE CRYSTALLIZATION METHOD,
Kurita Water Industries Ltd., Yokohama (Japan).
I. Joko.
Water Science and Technology, Vol. 17, No. 2/3, p 121-132, 1985. 13 Fig, 2 Tab, 12 Ref.

Descriptors: *Phosphorus removal, *Wastewater treatment, *Crystallization method, Calcium phosphate, Hydrogen ion concentration, Pilot plants.

To develop a new process for phosphorus removal the calcium phosphate crystallization method has been investigated. The metastable zone of calcium phosphate precipitates which is defined by concentrations of phosphate and calcium ions and pH was determined by batch experiments. Phosphorus in wastewaters can be constantly reduced to a sufficiently low level at the metastable reaction zone under the presence of seed crystals. The crystallization method proved to be practicable as advanced technology for phosphorus removal from wastewater through column tests and 50 cu m/day pilot plant tests over 180 days with a sewage secondary effluent. (Author's abstract)
W86-00741

PHOSPHATE REMOVAL BY CRYSTALLIZATION IN A FLUIDIZED BED,
DHV Consulting Engineers, Amersfoort (Netherlands).
J. C. van Dijk, and H. Braakensiek.
Water Science and Technology, Vol. 17, No. 2/3, p 133-142, 1985. 3 Fig, 6 Tab, 7 Ref.

Descriptors: *Phosphorus removal, *Fluidized bed reactors, *Crystallization method, Calcium phosphate, Recycling, Wastewater treatment.

Conventional methods for the removal of phosphates from wastewater produce a substantial amount of chemical sludge. A new process is described for the removal of phosphate from effluent from sewage treatment plants based on crystallization of calcium phosphate in a fluidized bed. No sludge is produced, only a small quantity of water-free pellets. The calcium phosphate pellets can be used in the phosphate industry, thus creating a simple and effective method of recycling phosphate. In 1984 a demonstration unit with a capacity of 270 cu m/d will be built. Cost calculations were prepared for a full-scale plant. (Moore-IVI)
W86-00742

BATCH ANAEROBIC METHANOGENSIS OF PHENOLIC COAL CONVERSION WASTEWATER,
Alberta Univ., Edmonton. Dept. of Civil Engineering.
P. M. Fedorak, and S. E. Hrudey.
Water Science and Technology, Vol. 17, No. 2/3, p 143-154, 1985. 5 Fig, 3 Tab, 15 Ref.

Descriptors: *Anaerobic digestion, *Methanogenesis, *Coal conversion wastewater, Phenols, Organic acids, Inhibitors, Wastewater treatment.

Batch experiments using the Hungate serum bottle technique were used to determine the anaerobic treatability of phenolic (7600 mg/l by 4-aminoantipyrine) wastewater from an H-coal conversion pilot plant. Methane production above controls was achieved at up to 6% V/V dilution. At these levels, inhibitory components in the wastewater retard but do not stop volatile organic acid (VOA) fermentation to methane. Ether-extracted wastewater was tested at up to 50% V/V cultures receiving 200 mg/l phenol and was found not to be inhibitory, suggesting that inhibitory components in the wastewater are ether-extractable. Finally, a 'reconstituted H-coal' which contained pure phenolic constituents added to ether-extracted H-coal exhibited batch methanogenesis above controls at H-coal dilutions up to 10% V/V. These findings indicate that the ether-extractable inhibitory substances are not one of the major phenolic compounds present in the H-coal wastewater. (Author's abstract)
W86-00743

THERMOPHILIC ANAEROBIC CONTACT DIGESTION OF PALM OIL MILL EFFLUENT,
Rubber Research Inst. of Malaya, Kuala Lumpur (Malaysia).
A. Ibrahim, B. G. Yeoh, S. C. Cheah, A. N. Ma, and S. Ahmad.
Water Science and Technology, Vol. 17, No. 2/3, p 155-166, 1985. 2 Fig, 6 Tab, 11 Ref.

Descriptors: *Anaerobic contact digestion, *Palm oil mills, *Thermophilic digestion, Anaerobic digestion, Malaysia, Wastewater treatment, Scum, Malaysia.

The palm oil industry in Malaysia generates enormous quantities liquid waste with high organic load causing serious pollution problems. Anaerobic pretreatment is usually practised prior to aerobic breakdown, and most of the anaerobic digesters operate under mesophilic conditions. The inherently high temperature of the effluent suggested that the thermophilic digestion would bring about a much more effective system. Pilot plant studies indicate that the anaerobic contact digester may be used for the digestion of palm oil mill effluent. At a temperature of 45 C, the digester could be operated at a maximum organic load of about 3.11 kg BOD/cu m/day, giving a percentage reduction of around 94%. A higher loading of about 3.44 kg kg BOD/cu m/day was tolerable at the higher temperature of 50 C, but some limitations in reactor design did not favor operation at these high loading rates. One obvious modification which may require incorporation is a provision for some scum breaking mechanism at the digester surface. (Moore-IVI)
W86-00744

OXIDATION OF SULFIDE AND THIOSULFATE AND STORAGE OF SULFUR GRANULES IN THIOTHRIX FROM ACTIVATED SLUDGE,
Odense Univ. (Denmark). Biological Inst.
P. H. Nielson.
Water Science and Technology, Vol. 17, No. 2/3, p 167-181, 1985. 3 Fig, 3 Tab, 36 Ref.

Descriptors: *Thiothrix, *Sulfides, *Thiosulfates, *Sulfur, *Activated sludge process, Bulking sludge, Sulfur bacteria, Wastewater treatment.

Thiothrix from activated sludge is, in the presence of oxygen, able to oxidize sulfide and thiosulfate and store many clear sulfur granules at sulfide concentrations less than about 1 mM and thiosulfate concentrations of 0.1-20 mM. On this basis, a sulfur storage test for the identification of Thiothrix in activated sludge was developed. It is shown that the filamentous bacteria, Type 021N (commonly causing bulking in sewage plants), is able to store sulfur granules and thus is a Thiothrix. In enrichment cultures with thiosulfate typical Thiothrix rosettes and motile gonidia are developed, and the presence of a sheath is demonstrated. Filamental diameter varies between 0.8-2.4 microm, the youngest filaments being thinnest. Attempts to isolate Thiothrix have been unsuccessful, but Thiothrix filaments with only a few contaminants are able to grow on solid media with acetate as the only carbon and energy source, indicating the presence of heterotrophic strains. The filamentous organisms of 14 Danish sewage treatment plants are identified, Thiothrix being the most common in 8, and responsible for bulking in 4 plants. (Author's abstract)
W86-00745

KINETIC STUDIES OF THE MICROBIOLOGICAL CONVERSION OF SULPHATE TO HYDROGEN SULPHIDE AND THEIR RELEVANCE TO SULPHIDE GENERATION WITHIN SEWERS,
Monash Univ., Clayton (Australia). Dept. of Chemical Engineering.
G. A. Holder, G. Vaughan, and W. Drew.
Water, Science and Technology, Vol. 17, No. 2/3, p 183-196, 1985. 7 Fig, 2 Tab, 17 Ref.

Descriptors: *Kinetics, *Sulfur bacteria, *Sewers, *Sulfides, Hydrogen sulfide, Mass transport, Mathematical equations, Model studies, Wastewater.

Corrosion of concrete sewers occurs as a result of hydrogen sulfide formation from sulfate-containing sewage. The problem arises because bacteria which utilize the sulfate ion as a source of oxygen flourish in warm anaerobic sewage. In order to design effectively form sulfide control, a reliable means of predicting the rate of sulfide production is desirable. Predictive equations presently in use are compared, and the desirability of replacing these empirical equations by a more scientific approach based on an analysis of mass transport and biochemical reaction is stressed. A theoretical analysis of mass transport and metabolism of sulfate during laminar flow in a model sewer is described. Laboratory experimental studies consisted of flowing simulated sewage through tubes containing biofilms of mixed cultures of sulfate reducing bacteria. The diffusional resistance in the liquid phase was negligible and the biological conversion of sulfate to sulfide followed zero order kinetics when mass transfer was not rate limiting. The observed sulfate removal rates gave good agreement with Australian field data for sulfide generation in sewers. The value of the zero order rate constant (measured at 41 C) was 30 mg/cu cm/h. The results of this study can be utilized to estimate potential hydrogen sulfide production in sewers. (Moore-IVI)
W86-00746

MIXING AND DETENTION TIME DISTRIBUTION IN ACTIVATED SLUDGE TANKS,

Hanover Univ. (Germany, F.R.). Inst. fuer Siedlungswasserwirtschaft.
H. Bode, and C. F. Seyfried.
Water, Science and Technology, Vol. 17, No. 2/3, p 197-208, 1985. 9 Fig, 14 Ref.

Descriptors: *Mixing, *Detention time, *Activated sludge process, Wastewater treatment, Tracers, Tanks, Plug flow, Aeration tanks, Particulate matter.

The manner in which wastewater is introduced into the tank and the mixing characteristics of the aeration tank are important parameters in the activated sludge process. Tracer test evaluation for activated sludge tank mixing is difficult due to the circulation of return sludge. The tracer response curves for tanks in plug flow and tanks in series approach the response curves of completely mixed tanks with increasing return sludge ratios. The return sludge cycle impedes the acquisition of definitive results considerably. The return sludge cycle produces invalid relevant concentration distribution for the aeration tank, due to delay of the return sludge in the secondary clarifyer and to multiple detection of tracer particles circulating in the return sludge cycle. Two methods for dealing with these difficulties are mentioned. One method applies to the case of tanks in parallel flow with common secondary clarification, the other applies to one line operation or several independent parallel lines. In the field, potentially existing stagnation zones in aeration tanks result in accelerated discharge of a portion of the influent as compared with stagnation-free tanks. This accelerated discharge is compensated for in the mean detention time by the delayed discharge of those particles found in the stagnation zones. Dead regions result, due to the lack of any liquid interchange whatsoever with the remaining tank contents, in an actual reduction of the mean detention time. The results from a field investigation of a tank with rotating flow demonstrate a clear difference between its tracer response curve and that for a completely mixed tank of equal size. (Moore-IVI)
W86-00747

INFLUENCE OF MACROMIXING ON ORGANIC CARBON UPTAKE AND SOLIDS PRODUCTION BY AEROBIC SUSPENDED BIOMASS,

Montpellier-2 Univ. (France). Lab. de Genie Chimique Applique aux Biotechnologies.
S. Elmaleh, T. L. Yoon, and A. Grasmick.
Water, Science and Technology, Vol. 17, No. 2/3, p 209-219, 1985. 9 Fig, 1 Tab, 15 Ref.

Descriptors: *Macromixing, *Organic carbon, *Aerobic digestion, *Aerobic suspended biomass, Mixing, Biological wastewater treatment, Kinetics, Solids production.

The influence of macromixing on organic carbon uptake by aerobic suspended biomass has been investigated using two reactors operated by parallel, i.e. a perfectly mixed reactor and a compartmented reactor. Conversion determined on filtrated samples is identical in both of the reactors but with less solids production in the low-dispersed reactor. The reaction rate established on the perfectly mixed reactor shows an apparent first-order with influence of inlet concentration but this relation cannot be used in a mass balance over the compartmented reactor. (Author's abstract)
W86-00748

EQUALIZATION CONTROL STRATEGY FOR ACTIVATED SLUDGE PROCESS CONTROL,

Cape Town Univ. (South Africa). Dept. of Chemical Engineering.
P. L. Dold, H. O. Buhr, and G. v. R. Marais.
Water, Science and Technology, Vol. 17, No. 2/3, p 221-234, 1985. 5 Fig, 7 Ref.

Descriptors: *Activated sludge process, *Process control, *Equalization control, Hydraulic load, Organic load, Automation, Microprocessors, Diurnal variation.

Fluctuations in hydraulic and organic loads cause wastewater treatment plant operating problems, necessitating some form of process control to ensure attainment of design objectives. A comparision of in-plant control with equalization control indicates that the latter is more appropriate for the case of long sludge age nutrient removal activated sludge processes which include anaerobic, anoxic and aerobic zones. A microprocessor-based control strategy is presented for the operation of an equalization tank upstream of the process to reduce, optimally, diurnal fluctuations in both flow and organic load rates. Results from implementation on a 150 Ml/d plant with an in-line equalization tank (4,5 hour mean retention time) demonstrate the successful performance of the control strategy. (Author's abstract)
W86-00749

A-B PROCESS: A NOVEL TWO STAGE WASTEWATER TREATMENT SYSTEM,

ESMIL International B.V., Amsterdam (Netherlands).
A. I. Versprille, B. Zuurveen, and T. Stein.
Water, Science and Technology, Vol. 17, No. 2/3, p 235-246, 1985. 7 Fig, 8 Tab, 15 Ref.

Descriptors: *Wastewater treatment, *A-B process, Organic load, Hydrogen ion concentration, Toxic shocks, Two-step treatment, Sludge.

New acts on wastewater disposal demand for higher process stability and effluent quality. The A-B process, a novel two step treatment system, meets these requirements in a cost effective way. Five full-scale plants have been put in operation over the last two years. The objective of this paper is to give an outline of the features of the A-B system in the context of the results of these full-scale plants. In spite of the extreme high load, the A-stage can be operated at a higher reduction rate and is stable. Variations in the organic load and pH- and toxic shocks are leveled out and a constant, mainly soluble effluent is supplied. This implicates a low sludge production in the B-state. As a consequence higher overall reduction rates are obtained as compared to conventional processes at the same sludge load. Very low and stable final effluent concentrations are observed in all full-scale plants. Of special interest are the possibilities of upgrading existing conventional treatment facilities, at minor costs, by incorporating the A-B technology. The A-B process therefore can be considered as a very promising, cost effective alternative for both existing and new wastewater treatment plants in responding to the increasing effluent demands. (Author's abstract)
W86-00750

FLEXIBLE MODELLING OF THE ACTIVATED SLUDGE SYSTEM - THEORETICAL AND PRACTICAL ASPECTS,

Environmental Protection Service, Jerusalem (Israel).
M. S. Sheffer, M. Hiraoka, and K. Tsumura.
Water, Science and Technology, Vol 17, No. 2/3, p 247-258, 1985. 10 Fig, 10 Ref.

Descriptors: *Flexible modelling, *Activated sludge process, Computer models, Algorithms, Wastewater treatment, Model studies, Mixed liquor solids.

For the purpose of optimal modelling, a 'Flexible Modelling' method was developed. A flexible set of models consisting of hierarchical mechanistic models derived from a highly detailed structured model by mechanistic simplification was obtained. The performance of a computer program with an algorithm for parameter fitting in the time domain was evaluated by use of simulation. The program was able to estimate the models' parameters, even when using data with different degrees of inaccuracy. A computer program for model selection was developed, whereby the model was selected according to the information required. It was found that for prediction of the dynamic behavior of the MLSS, the simplest model can supply all the necessary information. For prediction of effluent substrate concentration, the differences between the models' predictions depend on the characteristics of the disturbances and on the values of the models' parameters. The selection of the proper model and updating its parameters can be done by a computer which uses the presented program for model selection and parameter fitting. (Author's abstract)
W86-00751

DETERMINATION OF KINETIC CONSTANTS OF ACTIVATED SLUDGE MICROORGANISMS,

Vysoka Skola Chemicko-Technologicka, Prague (Czechoslovakia). Inst. of Water Technology and Environmental Protection.
J. S. Cech, J. Chudoba, and P. Grau.
Water, Science and Technology, Vol. 17, No. 2/3, p 259-272, 1985. 9 Fig, 5 Tab, 11 Ref.

Descriptors: *Activated sludge process, *Kinetics, *Microorganisms, Respirometry, Biological wastewater treatment, Substrate removal.

A method for measuring kinetic constants of activated sludge microorganisms by means of a simple respirometer was developed and tested by using two types of mixed culture. The method can be used for those substrates that cannot be easily determined analytically. It is much more sensitive than the methods based on the biomass growth or substrates removal. The method determines kinetic constants of mixed cultures at given loading and mean cell residence time without changing its qualitative and quantitative composition. Both the maximum substrate removal rate and the half-velocity coefficient are basically lower with the mixed cultures cultivated in a completely-mixed reactor (filamentous) than with those cultivated in a selector-type reactor (nonfilamentous). (Moore-IVI)
W86-00752

DEVELOPMENT OF POLLUTANT SPECIFIC MODELS FOR TOXIC ORGANIC COMPOUNDS IN THE ACTIVATED SLUDGE PROCESS,

Vanderbilt Univ., Nashville, TN. Dept. of Civil and Environmental Engineering.
A. T. Watkin, and W. W. Eckenfelder, Jr.
Water, Science and Technology, Vol. 17, No. 2/3, p 279-289, 1985. 4 Fig, 3 Tab, 15 Ref.

Descriptors: *Organic compounds, *Activated sludge process, *Model studies, Biological wastewater treatment, Phenol, Dichlorophenol, Dinitrophenol, Dinitrobenzene, Carbon tetrachloride, Volatilization, Biodegradation, Mathematical models.

The concept of pollutant specific models in completely mixed biological recycle reactors is developed. Pollutant specific Monod constants are developed by considering substrate utilization, cell growth, and endogenous decay rates based solely on influent and effluent specific pollutant concentrations. In this way, models are developed which predict specific pollutant removal in biological reactors. Three nonvolatile compounds are evaluated; namely, phenol, 2,4-dichlorophenol, and 2,4-dinitrophenol and their respective specific Monod constants determined. A pollutant specific model for concurrent biodegradation and volatilization is also developed. A mathematical method for evaluating the pollutant specific Monod constants independent of volatilization kinetics is derived for the volatile compounds dinitrobenzene and carbon tetrachloride. Control strategies are discussed which emphasize the rate limiting pollutant cncept. Conclusions are drawn as to the applicability and limitations of pollutant specific models. (Author's abstract)
W86-00754

KINETIC ANALYSIS OF BOD AND NITROGEN REMOVAL IN AN OXIDATION DITCH,

Kyoto Univ. (Japan). Dept. of Sanitary Engineering.
Y. Terashima, and M. Ishikawa.
Water, Science and Technology, Vol. 17, No. 2/3, p 291-302, 1985. 12 Fig, 4 Tab, 7 Ref.

Descriptors: *Nitrogen removal, *Biochemical oxygen demand, *Oxidation ditch, *Kinetics,

Model studies, Nitrification, Denitrification, Dissolved oxygen, Alkalinity, Computer models, Simulation.

The simultaneous removal of nitrogen as well as organic substances is one of the important characteristics of the oxidation ditch process. To describe this phenomena, synthetic kinetic models including the rates of BOD oxidation, nitrification, denitrification, DO and alkalinity changes, and sludge growth were proposed in this study. Rate equations for these mechanisms were mainly based on Monod type kinetics taking into account several limiting effects among these mechanisms. To develop the design procedure, these kinetic models were combined with the tank-in-series model having circulating and back flows. They were analyzed numerically for typical design and operating conditions. From these computer simulations, successful results to explain these complicated phenomena and several design and operating bases were obtained. (Author's abstract)
W86-00755

STEADY STATE MEASUREMENT OF OXYGENATION CAPACITY,
Amsterdam Public Works (Netherlands). Sewerage and Drainage Dept.
K. de Korte, and P. Smits.
Water, Science and Technology, Vol. 17, No. 2/3, p 303-311, 1985. 9 Fig, 1 Ref.

Descriptors: *Oxygenation capacity, *Steady state measurement, Activated sludge, Aeration, Oxygen saturation, Wastewater treatment.

Oxygenation capacity (OC) measurement by the non-steady state method (reaeration) in tapwater or in activated sludge is difficult and expensive. The steady state method for measuring OC using activated sludge is presented. OC measurement at steady state conditions with (endogenous) activated sludge is practicable for various aeration systems and results in values representative for the practical conditions during measurement. The alpha factor, which influences the oxygen transfer coefficient, depends on the waste characteristics and the type of aeration system. Because the waste characteristics change during treatment, the alpha factor is not constant. With increasing degree of treatment, the influence of the alpha factor decreases. The beta factor, which influence the oxygen saturation, depends on the dissolved solids. In most cases the oxygen saturation is hardly influenced and the oxygen saturation in activated sludge is practically the same as in pure water. Steady state OC measurement is easy to do, is not labor-intensive and consequently can be performed at low cost. The results are satisfactory for most purposes. (Moore-IVI)
W86-00756

REMOVAL OF IRON CYANIDE FROM GOLD MILL EFFLUENTS BY ION EXCHANGE,
Environmental Protection Service, Burlington (Ontario). Waste Water Technology Centre.
D. T. Vachon.
Water, Science and Technology, Vol. 17, No. 2/3, p 313-324, 1985. 6 Fig, 5 Tab, 8 Ref.

Descriptors: *Iron cyanide, *Gold mill wastes, *Ion exchange, Industrial wastewater, Cyanides, Iron compounds, Mine wastes, Resins, Regeneration.

Using a strongly basic anion exchanger (Rohm and Haas Amberlite IRA-958) laboratory ion exchange tests were conducted on the removal of iron cyanide from synthetic and actual gold mill effluents. Variables examined included the effects of pH, concentration and hydraulic loading of the feed on the resin exchange capacity and resin column utilization. The results showed ion exchange to be an effective method of removing iron cyanide to concentrations of less than 3 mg/L. Tests with synthetic gold mill effluents gave resin exchange capacities ranging from 13 to 34 mg CNFe/mL resin depending on the concentration of iron, copper and zinc cyanides in these solutions. When raw barren bleed was tested, an exchange capacity for the ferro/ferricyanides was determined to be about 6 to 8 mg CNFe/mL resin. For chlorinated barren bleed, a resin exchange capacity of 14 mg CNFe/mL resin was observed. A capacity of 19 mg CNFe/mL resin was achieved for tailings pond decant. Regeneration with 15% NaCl provided mixed results with recoveries ranging from 40 to 100% of the iron cyanide exchanged by the resin. Upon multiple exchange-regeneration cycles, the resin lost 25% of the exchange capacity for total cyanide during the first cycle. Subsequently, the loss in exchange capacity was approximately 1% per cycle. Pilot scale tests were considered essential prior to full scale system design. (Author's abstract)
W86-00757

TOTAL EFFLUENT TREATMENT AND RINSE WATER RECLAMATION IN A SEMICONDUCTOR DEVICE MANUFACTURING FACILITY,
C3 International, Minneapolis, MN.
P. S. Cartwright.
Water, Science and Technology, Vol. 17, No. 2/3, p 325-336, 1985. 2 Fig.

Descriptors: *Metal-finishing wastes, *Semiconductor industry, *Wastewater renovation, Water reuse, Wastewater treatment, Electroplating, Copper, Nickel, Ultrapure water, Industrial wastewater.

A manufacturer of semiconductor devices uses several electroplated coatings during the production process. After each plating bath, the devices are rinsed in ultrapure water. Three of the baths contain toxic heavy metals (copper and nickel). In order to minimize the volumetric discharge containing the metals as well as the costs of purifying large quantities of raw water, a complete reclamation and waste treatment system was installed. The system consists of the rinse water reclamation system, the make-up water system, the polishing system, and the waste treatment system. Over 90% of the rinse water is purified back to 18 megohm/cm quality of reuse, and the concentrated toxic chemicals are precipitated and disposed of as an insoluble sludge. Based on maximum rinse water flow of 72,000 gallons per day, the total operating cost is $251.41/day. (Moore-IVI)
W86-00758

DEVELOPMENT OF A NEW PROCESS FOR TREATING URANIUM MINING EFFLUENTS,
Alberta Univ., Edmonton. Dept. of Civil Engineering.
P. M. Huck, W. B. Anderson, and R. C. Andrews.
Water, Science and Technology, Vol. 17, No. 2/3, p 337-350, 1985. 3 Fig, 9 Tab, 7 Ref.

Descriptors: *Uranium mines, *Mine wastes, *Radium, *Coprecipitation, Wastewater treatment, Fluidized bed process, Barium sulfate, Radium sulfate, Radioactive wastes.

Decants from Canadian uranium mining tailings areas are treated to remove radium-226 prior to discharge into the environment. This paper describes the development of a new treatment process for these effluents. This new process differs from existing systems in that it involves the use of a fluidized bed to facilitate (Ba,Ra)SO4 coprecipitation on a granular medium of high surface area. No solids separation step is required, as the granular material is free draining. The new process has been demonstrated to provide radium-226 removal efficiencies consistently exceeding 90% in contact times of about 20 seconds. These short times are in contrast to times on the order of days for conventional pond systems or hours for mechanical systems involving stirred tank precipitation reactors. (Author's abstract)
W86-00759

DYNAMICS OF NITRIFICATION IN A BIOLOGICAL FLUIDIZED BED REACTOR,
Toledo Univ., OH. Dept. of Civil Engineering.
S. W. Hermanowicz, and J. J. Ganczarczyk.
Water, Science and Technology, Vol. 17, No. 2/3, p 351-366, 1985. 5 Fig, 3 Tab, 37 Ref.

Descriptors: *Fluidized bed process, *Nitrification, Biological wastewater treatment, Mathematical models, Simulation, Substrate removal, Biomass, Microorganisms, Mass transfer, Biofilms, Kinetics.

Dynamics of nitrification in a biological fluidized bed reactor was investigated with numerical simulations and experimentally in a small scale reactor. A mathematical model was developed describing reactor dynamics, substrate removal and biomass development. Variable microbial activity was used as a quantitative representation of the state of the microorganisms. External and internal mass transfer limitations were considered in substrate removal modelling. The effects of biofilm growth on reactor hydrodynamics and on substrate removal kinetics were incorporated into the model. In the experimental part, the performance of the nitrifying fluidized bed was monitored as the influent concentration was varied following an irregular square wave pattern. The observed changes of the effluent concentration depended not only on actual conditions but also on the past history of the system. Further analysis was carried with the help of the developed model. The concept of variable microbial activity was instrumental in explanation of the microbial dynamics. Predictive capacities of the properly calibrated model were demonstrated. (Author's abstract)
W86-00760

MODELING, OPTIMIZATION AND DESIGN OF FLUIDIZED BEDS FOR BIOLOGICAL DENITRIFICATION,
Technische Hogeschool Delft (Netherlands). Lab. of Sanitary Engineering.
T. J. Nieuwstad.
Water, Science and Technology, Vol. 17, No. 2/3, p 367-383, 1985. 7 Fig, 3 Tab, 27 Ref.

Descriptors: *Fluidized bed process, *Denitrification, *Model studies, *Optimization, Mathematical models, Biological wastewater treatment, Nitrates, Nitrites, Kinetics, Particle size.

A mathematical model for fluidized bed denitrification has been derived, based on the fluidization theory and on zero order kinetics for biological nitrate reduction with nitrite as an intermediate product. Bed expansion, particle size, sludge concentration and nitrate and nitrite concentration can be calculated as a function of the height in the bed. Complete optimal conditions were not found using carrier materials of various specific gravities and with sizes above a radius of 0.2 mm, which was arbitrarily chosen as the smallest carrier particle. However, for each size and type of carrier material an optimal thickness of the biomass layer has been calculated for a standard type of wastewater at constant flow rate. For the kinetic and other constants used in this study, graphs are presented which can be used in the design of fluidized beds for denitrification. (Author's abstract)
W86-00761

MATHEMATICAL MODEL OF SIMULTANEOUS ORGANIC OXIDATION, NITRIFICATION, AND DENITRIFICATION IN ROTATING BIOLOGICAL CONTACTORS,
Miyazaki Univ. (Japan). Dept. of Civil Engineering.
Y. Watanabe, S. Masuda, K. Nishidome, and C. Wantawin.
Water, Science and Technology, Vol. 17, No. 2/3, p 385-397, 1985. 14 Fig, 4 Tab, 11 Ref.

Descriptors: *Mathematical models, *Oxidation, *Nitrification, *Denitrification, *Rotating biological contactors, Biological wastewater treatment, Simulation, Organic matter, Computer models.

Simultaneous organic oxidation and nitrification rates in the RBC (rotating biological contactor) are given using a mathematical equation. The equation was derived from a hypothesis stating that intrinsic oxygen uptake rate of the biofilm has a constant value at a fixed temperature, independent of the composition of the aerobic bacteria. Based on this hypothesis, empirical equations are proposed to describe the profile of intrinsic organic oxidation and nitrification rates. Computer simulation of the simultaneous organic oxidation and nitrification

was carried out to confirm the empirical equations. The mathematical model of the simultaneous nitrification and denitrification is discussed and was tested by computer simulation. (Author's abstract)
W86-00762

APPLICATION OF PREDENITRIFICATION NITRIFICATION TECHNOLOGY FOR TRACE CONTAMINANT CONTROL,
Environmental Protection Service, Burlington (Ontario). Waste Water Technology Centre.
H. Melcer, and S. G. Nutt.
Water, Science and Technology, Vol. 17, No. 2/3, p 399-408, 1985. 2 Fig, 5 Tab, 21 Ref.

Descriptors: *Predenitrification nitrification, *Wastewater treatment, Coke plant wastewater, Coal liquefaction wastewater, Industrial wastewater, Activated sludge process, Fluidized bed process, Trace compounds, Organic compounds.

Predenitrification nitrification (PDN) technology was applied in two stage anoxic-aerobic systems treating coke plant wastewaters and coal liquefaction process condensates. Both activated sludge and biological fluidized bed modes of operation were investigated for their potential to remove ammonia, phenol, thiocyanate, cyanide and a wide range of trace organic contaminants. It was demonstrated that during nitrification of these complex wastewaters, simultaneous removal of most of the conventional and trace organic contaminants was achieved. Specifically, of the base/neutral extractable organic compounds, only di-n-butyl phthalate was consistently found in treated effluent samples at greater than trace levels (0.01 mg/l). It appears that trace organic contaminant control in complex industrial wastewaters can be achieved by the application of PDN technology. (Author's abstract)
W86-00763

ELEVATED NITRITE OCCURRENCE IN BIOLOGICAL WASTEWATER TREATMENT SYSTEMS,
Purdue Univ., Lafayette, IN. School of Civil Engineering.
J. E. Alleman.
Water, Science and Technology, Vol. 17, No. 2/3, p 409-419, 1985. 6 Fig, 43 Ref. NSF grant CME-6006856.

Descriptors: *Nitrites, *Biological wastewater treatment, Ammonium, Nitrification, Temperature effects, Carbon dioxide, Oxygen, Hydrogen ion concentration, Nitrates.

Although nitrite plays a critical intermediary role in nitrification, it is generally regarded as a nominal constituent of nitrified wastewater effluents. Bench-scale and full-scale nitrification systems have reportedly encountered elevated nitrite concentrations. Several concerns are generated by this circumstance, including: an increased chlorine demand, an increased effluent nitrogenous oxygen demand, potential nitrite toxicity, and possible nitrosamine formation. An overview is provided of seven conditions which could lead to elevated nitrite occurrence in biological nitrification systems. The seven conditions include: reduced temperatures; limiting O2 or CO2 presence; elevated pH; free ammonia presence; elevated solids wastage; acute process loadings; and cryptic nitrate reduction. (Moore-IVI)
W86-00764

SINGLE SLUDGE ANOXIC-AEROBIC SYSTEMS FOR BIOLOGICAL TREATMENT OF COKE PLANT WASTEWATERS,
Istituto di Ricerca sulle Acque, Rome (Italy).
M. Beccari, A. C. Di Pinto, R. Passino, R. Ramadori, and V. Tandoi.
Water, Science and Technology, Vol. 17, No. 2/3, p 421-432, 1985. 3 Fig, 6 Tab, 13 Ref.

Descriptors: *Biological wastewater treatment, *Coke plant wastewater, *Single sludge process, Aerobic digestion, Anaerobic digestion, Phenols, Ammonium, Design criteria, Costs.

A study on the biological treatment of coke plant liquid wastes, with high concentration of ammonium nitrogen and phenols, is presented. The anoxic-aerobic single sludge process is used, with the phenols as electron donors in the denitrification process; the inhibiting effect of toxic substances present in the wastewater is prevented by means of dilution. Tests were conducted in a laboratory scale plant to determine the minimum dilution ratio necessary to avoid inhibition and the parameters required for the designing of a full scale plant. Finally the basic design considerations of a wastewater treatment plant for a 1000 t/d coke plant are reported and capital and running costs are evaluated. (Author's abstract)
W86-00765

UV INACTIVATION OF PATHOGENIC AND INDICATOR MICROORGANISMS,
North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
J. C. H. Chang, S. F. Ossoff, D. C. Lobe, M. H. Dorfman, and C. M. Dumais.
Applied and Environmental Microbiology, Vol. 49, No. 6, p 1361-1365, June, 1985. 4 Fig, 31 Ref. EPA grant R809593010.

Descriptors: *Ultraviolet radiation, *Disinfection, *Pathogens, *Bioindicators, Bacteria, Viruses, Protozoans, Coliforms, Microorganisms, Spores, Cysts, Wastewater treatment, Water treatment.

Survival was measured as a function of the dose of germicidal UV light for the bacteria Escherichia coli, Salmonella typhi, Shigella sonnei, Streptococcus faecalis, Staphylococcus aureus, and Bacillus subtilis spores, the enteric viruses poliovirus type 1 and simian rotavirus SA11, the cysts of the protozoan Acanthamoeba castellanii, as well as for total coliforms and standard plate count microorganisms from secondary effluent. The doses of UV light necessary for a 99.9% inactivation of the cultured vegetative bacteria, total coliforms, and standard plate count microorganisms were comparable. However, the viruses, the bacterial spores, and the amoebic cysts required about 3 to 4 times, 9 times, and 15 times, respectively, the dose required for E. coli. These ratios covered a narrower relative dose range than that previously reported for chlorine disinfection of E. coli, viruses, spores, and cysts. (Author's abstract)
W86-00774

METHANOGENESIS IN AN UPFLOW ANAEROBIC SLUDGE BLANKET REACTOR AT PH 6 ON AN ACETATE-PROPIONATE MIXTURE,
Agricultural Univ., Wageningen (Netherlands). Dept. of Water Pollution Control.
E. ten Brummeler, L. W. Hulshoff Pol, J. Dolfing, G. Lettinga, and A. J. B. Zehnder.
Applied and Environmental Microbiology, Vol. 49, No. 6, p 1472-1477, June, 1985. 9 Fig, 2 Tab, 24 Ref.

Descriptors: *Methanogenesis, *Upflow anaerobic sludge blanket process, Anaerobic digestion, Biological wastewater treatment, Methanothrix, Methanosarcina, Sludge, Hydrogen ion concentration.

High-rate anaerobic digestion can be applied in upflow anaerobic sludge blanket reactors for the treatment of various wastewaters. In upflow anaerobic sludge blanket reactors, sludge retention time is increased by a natural immobilization mechanism (viz. the formation of granular type of sludge). When this sludge is cultivated on acid-containing wastewater, the granules mainly consist of an acetoclastic methanogen resembling Methanothrix soehngenii. This organism grows either in rods or in long filaments. Attempts to cultivate a stable sludge consisting predominantly of Methanosarcina sp. on an acetate-propionate mixture as substrate by lowering the pH from 7.5 during the start-up to approximately 6 failed. After 140 days of continuous operation of the reactor a filamentous organism resembling Methanothrix soehngenii prevailed in the sludge. The specific methanogenic activity of this sludge on acetate-propionate was optimal at pH 6.6 to 6.8 and 7.0 to 7.2, respectively. (Author's abstract)
W86-00776

SEWAGE EFFLUENT PUMPS,
Texas Agricultural Experiment Station, College Station.
B. L. Carlile.
Southwest and Texas Water Works Journal, Vol. 67, No. 2, p 10 and 12, May, 1985. 1 Fig.

Descriptors: *Low pressure pipe septic systems, *Pumps, *Septic tanks, Soil water, Wastewater irrigation, Mound waste systems, Wastewater disposal.

The low pressure pipe (LPP) septic system provides the greatest promise in home waste disposal because it has demonstrated a remarkable ability to work successfully in the marginal to poor soils that predominate in today's suburban developments. The LPP is a pressure-dosed soil absorption system composed of seven basic elements: (1) septic tank, (2) pumping tank, (3) submersible sewage effluent pump and controls, (4) high-water alarm, (5) supply line and manifold, (6) distribution network, and (7) suitable soil area. Effluent is forced uniformly through holes in a network of drill-perforated polyvinyl chloride pipe, with 1/8-1/4 inch holes spaced 3 to 8 ft apart. The greatest future for sewage effluent pump systems appears to be in small community and cluster housing systems, an application in which it has already gained some acceptance from the Environmental Protection Agency and lending institutions. Other applications of sewage effluent pumps are found in mound waste systems and wastewater irrigation systems. (Rochester-IVI)
W86-00803

ANOMALIES ARISING FROM ARBITRARY MEASURES OF THE STRENGTH OF SEWAGE,
T. Stones.
Effluent and Water Treatment Journal, Vol. 25, No. 3, p 103-107, March, 1985. 8 Tab, 16 Ref.

Descriptors: *Wastewater, *Physicochemical characteristics, *Oxygen demand, Biochemical oxygen demand, Permanganate value, McGowan strength, Chemical oxygen demand, Nitrogenous oxygen demand, Total oxygen demand, Chemical characteristics, Effluent charges.

Characteristics of biochemical oxygen demand (BOD), permanganate value (PV), McGowan strength, chemical oxygen demand (COD), nitrogenous oxygen demand (NOD), and total oxygen demand (TOD) as measures of the strength of sewage were compared. Comparisons of BOD and PV of sewage with the COD have shown that the proportion of the total carbonaceous oxygen demand that they represent varies with the qualitative composition of the sewage. As a result, neither of these arbitrary parameters provides truly comparative measures of the total carbonaceous oxygen demand. They also fail to account for the NOD placed on a treatment plant or, in the case of highly nitrified effluents, the degree of nitrogenous oxidation that has been effected during treatment. Use of these arbitrary measures of sewage strength causes problems in plant management and in proper assessment of trade effluent charges. The BOD and PV measures give results that, in trade effluent charge situations, would cause the industry to be undercharged for treatment if BOD were used, and overcharged if PV were used. The ratio of BOD to COD does, however, give a rational indication of the amenability of sewage to treatment. TOD affords a valid overall criterion for realistic assessment of the capacity and performance of sewage treatment plants, and it provides a means of differentiating between the changes that have been effected in the carbonaceous and nitrogenous oxygen demands during treatment. TOD provides an equitable basis for levying trade effluent charges. (Rochester-IVI)
W86-00814

LUMPED-PARAMETER MODELING OF MULTICOMPONENT ADSORPTION IN THE TREATMENT OF COAL-CONVERSION WASTEWATER BY GAC,
Michigan Univ., Ann Arbor.

D. D. Endicott, and W. J. Weber, Jr.
Environmental Progress, Vol. 4, No. 2, p 105-111, May, 1985. 11 Fig, 8 Tab, 10 Ref.

Descriptors: *Adsorption, *Granular activated carbon, *Coal-conversion wastewater, *Lumped parameter value, *Wastewater treatment, Industrial wastewater, Model studies, Phenols, Cresol, Nitrophenol, Chlorophenol, Total organic carbon.

Granular activated carbon (GAC) adsorption of synthetic, multicomponent coal conversion wastewater was modeled as a lumped parameter using a single component version of the two resistance model (MADAM: Michigan Adsorption Design and Applications Model). The predictive ability of this system was quite good. Synthetic coal conversion wastewaters consisted of different concentrations of phenol, p-cresol, o-nitrophenol, and p-chlorophenol; total organic carbon, the lumped parameter measure, was 932 mg/l in 3 solutions, 646 mg/l in the other two. Values of the standard deviation between model prediction and independent GAC column verification ranged from 3.2 to 17%. Completely mixed batch reactor isotherm and short bed adsorber (SBA) experiments produced adequate adsorption parameters for lumped parameter modeling. The values of the film transfer coefficient obtained by the SBA technique were significantly smaller than those calculated by a correlation procedure. The values of intraparticle surface diffusion coefficient were fairly consistent with reported values of this coefficient for the primary wastewater component phenol. Verification of the model predictions with deep bed adsorber breakthrough data confirmed the validity of the modeling technique for this system. Isotherm parameters had a large influence upon the accuracy of model predictions. The categorization of wastewater solutions based on multicomponent diversity aided in the selection of optimal isotherm parameters for a given DBA prediction. The accuracy of MADAM in modeling the adsorption of synthetic coal conversion wastewater appears sufficient to warrant its use for preliminary design of GAC treatment systems for this application. (Rochester-IVI)
W86-00815

REMOVAL OF PHOSPHATE AT SEWAGE TREATMENT WORKS AND IMPLICATIONS ON PHOSPHATE LOADINGS INTO LOUGH NEAGH,
Department of Economic Development, Lisburn (Northern Ireland). Water Quality Branch.
A. V. Gray.
Journal of the Institution of Water Engineers and Scientists, Vol. 39, No. 2, p 137-154, April, 1985. 14 Fig, 3 Tab, 13 Ref.

Descriptors: *Phosphorus removal, *Wastewater treatment, *Lough Neagh, *Ireland, Ferrric aluminum sulfate, Phosphorus loading, Algal growth, Costs.

Installation of ferric aluminum sulfate (FAS) liquor dosing for phosphorus removal at 10 sewage treatment works (STW) around Lough Neagh (Northern Ireland) resulted in a reduction of annual phosphorus loading from the STWs from 118 tonnes to 22 tonnes, a change which is estimated to significantly reduce algal growth in the Lough within 5-6 yr. The FAS coagulant was produced by mixing sulfuric acid with ferruginous bauxite mined locally. Laboratory evaluation of the FAS coagulation method showed when good phosphorus removals were achieved, there were correspondingly small metal residuals, suggesting no potential for a metal build-up problem. In addition, biochemical oxygen demand (BOD) reductions were increased by FAS dosing. At the Bullays Hill STW, a trickling filter plant receiving variable strength sewage, an extra 31-40% BOD reduction was obtained in the primary stage due to FAS dosing, suggesting that the method might be an effective means of obtaining a better quality final effluent at less cost than extending the STW in the conventional manner. All plants were ultimately set up for FAS dosing, and successfully achieved the target level of less than 1 mg/l P in the effluent. Isolated instances of pulses of high-P waste disrupted some operations, however. The daily FAS requirement for one plant receiving 10,900 cu m/day was 2,670 l, which at the time cost 92 pounds sterling. The overall volumetric increase in sludge as a result of the FAS dosing procedure was anticipated to be about 50%. (Rochester-IVI)
W86-00834

SURVEY TIES NEEDS TO WATER QUALITY,
A. B. Nichols.
Journal of the Water Pollution Control Federation, Vol. 57, No. 5, p 355-357, May, 1985. 2 Tab.

Descriptors: *Wastewater treatment, *Costs, *Water quality control, Population dynamics, Poliution load, Water pollution.

According to the 1984 U.S. Environmental Protection Agency (EPA) Needs Survey Report to Congress, $85 billion would be required to meet the wastewater treatment needs of the 1984 population of the United States and its territories, $101.7 billion to meet eligible year 2000 needs, and $108.9 billion to meet total (unrestricted) needs for the year 2000. Areas with relatively high needs for publicly owned wastewater treatment to the year 2000 include California (6,313 million), Florida ($4,533 million), Illinois ($4,204 million), Massachusetts (4,696 million), New Jersey ($4,684 million), New York ($15,184 million), Ohio ($ 4,834 million), Pennsylvania ($4,749 million), and Texas ($4,145 million). When 1984 needs are met, an estimated 32% more people (approximately 70 million) will receive treatment services, and pollutant load will drop 34%, resulting in improved water quality in streams throughout the country. The service population is estimated to increase by 55% by the year 2000 and the aggregate effluent load is estimated to increase 9%. The increase in pollutant removal capacity at municipal facilities probably will not keep pace with increased population growth. As a result, if year 2000 needs are met, water quality in the nation overall will remain about the same as today, but if the year 2000 needs are not met, severe water quality degradation will result. State planning has not been sufficient to fully address the impact of future pollutant loads resulting from bringing treatment services to more people. (Rochester-IVI)
W86-00838

INNOVATIVE WATER MANAGEMENT PLAN REDUCES TREATMENT COSTS,
Culp/Wesner/Culp, Denver, CO.
B. R. Willey, and H. H. Benjes, Jr.
Journal of the Water Pollution Control Federation, Vol. 57, No. 5, p 378-383, May, 1985. 5 Fig, 5 Tab, 2 Ref.

Descriptors: *Wastewater treatment facilities, *Costs, Water management, Wastewater lagoons, Effluents, Ammonia, Water rights, Irrigation water, Trout streams, Water quality standards.

A four-cell lagoon system was designed and constructed to serve the town of Buffalo, Wyoming (population about 5,000). Reassessment of ammonia discharge criteria using a predictive model was the key to meeting stream criteria while resolving water rights issues and lowering charges. Discharge from the treatment plant to Clear Creek, a trout stream, occurs only from October through April of each year, with discharge into irrigation ditches during the rest of each year. Chlorination is employed only when discharging to irrigation ditches. The primary cells, which operate in parallel, are aerated to maximize treatment, prevent ice formation during winter, and minimize odors. All lagoons are lined with a bentonite-soil mixture to protect underlying groundwater. Gravity inflow to the primary cell eliminates the need for a raw wastewater pumping station, but pumping up through the polishing cells is required to conform to site topography. Implementation of this water management plan resulted in a present-worth saving of $4 million compared to an oxidation ditch system, the only acceptable conventional alternative in Wyoming. (Rochester-IVI)
W86-00841

USE OF A SWIRL CONCENTRATOR FOR COMBINED SEWER OVERFLOW MANAGEMENT,
Crawford, Murphy and Tilly, Inc., Springfield, IL.
G. Heinking, and N. Wilcoxon.
Journal of the Water Pollution Control Federation, Vol. 57, No. 5, p 398-402, May, 1985. 3 Fig, 1 Tab, 4 Ref.

Descriptors: *Combined sewer overflows, *Swirl concentrators, Wastewater treatment facilities, Suspended solids, Biochemical oxygen demand, Costs, Decatur, Illinois, Sangamon River.

Construction of combined sewer overflow (CSO) facilities that include a storage tank and swirl concentrator appears to be the most cost-effective solution to the CSO problem in Decatur, Illinois. Wide variations in biochemical oxygen demand and total suspended solids levels are to be expected from this system, however. Decatur is a city of more than 90,000 population that occasionally discharges CSO into the Sangamon River, which during summer months is nearly dry. To solve this problem various alternatives were considered, and a storage facility for 'first-flush' flow, plus a swirl concentrator to separate solids, was chosen as the most cost-effective solution and was approved by the Illinois Environmental Protection Agency. The swirl concentrator induces a swirl action in a liquid for solids separation, and is able to handle much higher flow rates for a given surface area and tank volume than conventional settling tanks. To reduce the size of the CSO facilities, an optimization study was conducted to ensure that intercepting sewer capacities were used effectively. The design for Decatur required five CSO plants. The plant at McKinley Ave., analyzed here in detail, was estimated to cost $1,273,800 in 1981; a plain settling-type CSO control facility was estimated at the same time to cost $2,273,700. Estimated annual operational costs for the two types of facilities were estimated at $156,540 and $231,800, respectively. (Rochester-IVI)
W86-00844

EFFECT OF AERATION, CADMIUM CONCENTRATION, AND SOLIDS CONTENT ON ACID EXTRACTION OF CADMIUM FROM A MUNICIPAL WASTEWATER SLUDGE,
Ohio State Univ., Columbus.
T. J. Logan, and R. E. Feltz.
Journal of the Water Pollution Control Federation, Vol. 57, No. 5, p 406-412, May, 1985. 6 Fig, 4 Tab, 13 Ref.

Descriptors: *Aeration, *Acid extraction, *Cadmium, *Sludge, Zinc, Nickel, Metals, Wastewater treatment.

Large amounts of Cd, Zn, and Ni, three trace elements of concern in land application of wastewater sludges, can be removed from anaerobically-digested wastewater sludges with extended aeration. Sludge from Kent, Ohio, was used for all experiments because of its relatively high Cd content (> 1,000 mg/kg); otherwise the sludge was typical of sludges in this part of the USA. Extended aeration (up to 14 days) necessary to oxidize inorganic and organic forms of Cd and convert the metal to acid-extractable forms. Aeration during the acid-extraction step was necessary to maintain Cd in an acid-extractable form and eliminated the need for additional extensive aeration prior to acid addition. Acid-extraction at pH 2 for 18 hr removed an average of 76% of the Cd. Cd acid extraction was positively correlated with Cd content in the original sludge and negatively correlated with sludge solids content. In addition, more than 70% of the Zn, Ni, Ca, and Mn were acid-extractable, and more than 25% of the Cu, Mg and K, 15% of the Fe, and less than 5% of the Pb, Cr, P, and Al were removed by the aerated acid-extraction procedure. (Rochester-IVI)
W86-00846

STRUCTURED MODELING OF THE ANAEROBIC DIGESTION OF BIOMASS PARTICULATES,
Eidgenoessische Anstalt fuer Wasserversorgung,

Abwasserreinigung und Gewaesserschultz, Duebendorf (Switzerland).
J. D. Bryers.
Biotechnology and Bioengineering, Vol. 27, No. 15, p 638-649, May, 1985. 11 Fig, 3 Tab, 26 Ref, 1 Append.

Descriptors: *Structured modelling, *Anaerobic digestion, *Mathematical models, *Biomass, Model studies, Biodegradation, Biological treatment, Digestion, Sludge digestion, Chemical reactions.

Anaerobic digestion of biological organic particulates to methane was described by a structured mathematical model based on multiple-reaction stoichiometry, conventional material balances, and liquid phase equilibrium chemistry. A general stoichiometric treatment for any set of multiple biological reactions was derived based on a unit mass of oxygen equivalents of the reactions limiting substrate. The resultant model was calibrated to existing laboratory studies of mesophilic (35 C) acid phase and thermophilic (50-60 C) anaerobic digestion of waste-activated sludge. The model agrees well with two existing experimental studies of anaerobic digestion of biomass particulates. Hypothetical computer simulations illustrated possible instabilities of the anaerobic process under various operating scenarios. Digester pH dynamics are a complex interaction of liquid phase chemistry, gas transfer, and biological reaction. In this respect a structured model is capable of accounting for the various intermediates that exert direct influence on pH equilibrium while an unstructured model is not. (Collier-IVI)
W86-00848

BIOLOGICAL TREATMENT OF LANDFILL LEACHATES,
Rutgers - The State Univ., Piscataway, NJ. Dept. of Chemical and Biochemical Engineering.
E. S. Venkataramani, R. C. Ahlert, and P. Corbo.
CRC Critical Reviews in Environmental Control, Vol. 14, No. 4, p 333-376. 15 Fig, 12 Tab, 144 Ref.

Descriptors: *Biological treatment, *Wastewater treatment, *Landfills, *Leachates, Water analysis, Water treatment, Environmental impact, Activated sludge process, Anaerobic digestion.

Characteristics of sanitary and industrial landfill leachates are described, and problems of their correct characterization are reviewed. Microbial degradation of anthropogenic and recalcitrant compounds, including aromatic compounds, is also reviewed, and aerobic biostabilization, anaerobic biostabilization, and physical/chemical treatment of sanitary landfill leachate are described. Biological treatment of hazardous wastewater and industrial landfill leachates is discussed, and case studies of growth rate, respiration, fate of organic carbon, and other microbial responses, and of in situ and on-site biodegradation of industrial landfill leachates, are described. Biological processes are generally very cost effective; they have been employed successfully at full scale to a wide variety of industrial wastes. Environmental impacts associated with biological processes are usually limited. Biological treatment methods should be considered because disposal site leachate invariably contains large amounts of oxygen-demanding material. The activated sludge process, or a modification of it, appears to have the greatest potential for application to industrial leachate treatment. It can be controlled to a great extent, and lends itself to the development of an acclimated culture. Anaerobic digestion, because of minimal sludge production and high energy efficiency, merits consideration in some situations. Studies with sanitary landfill leachate treatment indicate that biological methods, such as activated sludge, anaerobic filtration, aerated lagoons, and combined treatment, are applicable for treating such leachate from new dump sites. Physical/chemical treatment methods, such as adsorption on activated carbon, chemical precipitation, chemical oxidation, and reverse osmosis, are best applied to biologically stabilized leachate. (Rochester-IVI)
W86-00856

BIOLOGICAL REMOVAL OF PHOSPHORUS FROM WASTEWATER,
Technical Univ. of Denmark, Lyngby. Dept. of Sanitary Engineering.
E. Arvin.
CRC Critical Reviews in Environmental Control, Vol. 15, No. 1, p 25-64. 13 Fig, 15 Tab, 102 Ref.

Descriptors: *Biological treatment, *Phosphorus removal, *Wastewater treatment, Water treatment, Nitrates, Anaerobic digestion, Sludge digestion.

Principles of the main treatment processes for removal of P from wastewater, the mechanism of biological P removal, chemical phosphate precipitation in biological P-removal systems, characterization of P fractions in sludge, factors in design of mainstream and sidestream treatment plants, and operational problems of these plants are reviewed. Sidestream processes are able to reduce P to a level of about 1 mg of P per liter under optimal conditions; mainstream processes, under optimal conditions, can reduce P to about 2 mg/l, which, with a small dosage of iron or aluminum salt, can be further reduced to 1 mg/l. Both sidestream and mainstream processes may require effluent filtration if the effluent P concentration must comply with stringent limits. This is due to the relatively high P content in the sludge, about 4% of P in sidestream process and 3.5-6% in mainstream processes. The extent of biological P removal from wastewater increases with increasing concentrations of soluble, readily biodegradable organics in the sewage. Nitrate and oxygen in the influent to the anaerobic reactor decrease biological P removal through oxidation of the soluble, readily biodegradable organic matter. The reactor design in biological P-removal plants is normally based on simple criteria like (aerobic) sludge age and detention times. Future design will most likely be based on process models that take into consideration the specific composition of the wastewater. New models emphasize the role of poly-P-accumulating bacteria. (Rochester-IVI)
W86-00857

DESTROYING PYROGENS IN WATER,
Electricity Council Research Centre, Capenhurst (England).
For primary bibliographic entry see Field 5F.
W86-00870

ACTIVATED BIOFILTER PROCESS FOR WASTEWATER TREATMENT,
Regina Univ. (Saskatchewan). Faculty of Engineering.
T. Viraraghavan, R. C. Landine, E. L. Winchester, and G. P. Wasson.
Effluent and Water Treatment Journal, Vol. 25, No. 4, p 129-134, April, 1985. 1 Fig, 6 Tab, 15 Ref.

Descriptors: *Wastewater treatment, *Activated biofilters, *Trickling filters, *Activated sludge process, *Biofilters, Filters, Water treatment, Cold regions, Costs, Economic aspects, Secondary wastewater treatment.

The activated biofilter (ABF) process is a hybrid of attached (trickling filter) and suspended (activated sludge) growth systems. For most domestic wastes the biocell is typically designed at a biochemical oxygen demand (BOD) loading of 3.2 kg/cu m per day. The settleability of the mixed liquor obtained from the biocell tower is quite good, even under severe shock loading. Numerous pilot studies have been conducted by the manufacturer and a case study was conducted by the US Environmental Protection Agenvcy at Helena, Montana. ABF was evaluated along with other processes for employment at Millidgeville, Saint John, New Brunswick, Canada, where a capacity of 6,820 cu m/day was anticipated based on service to a population of 12,000. Total present value costs for the competing systems were as follows: modified activated sludge process, $6,647,000; ABF, $6,023,000; rotating biological contactor system, $5,990,000; and deep shaft process, $7,431,000 (base design) or $7,625,000 (optimal design). Based on the economic criteria, plus energy, site, operational, and other considerations, ABF was recommended for secondary treatment at Millidgeville. The ABF system confers operational stability inherent in a trickling-filter system. Employment of short-term aeration as part of the process improves reliability. Heat loss across the system is minimal, an advantage in cold-climate operation. (Rochester-IVI)
W86-00871

PERFORMANCE OF AN UPFLOW ANAEROBIC REACTOR COMBINING A SLUDGE BLANKET AND A FILTER TREATING SUGAR WASTE,
National Research Council of Canada, Ottawa (Ontario). Div. of Biological Sciences.
S. R. Guiot, and L. van den Berg.
Biotechnology and Bioengineering, Vol. 27, No. 6, p 800-806, June, 1985. 12 Fig, 4 Tab, 11 Ref.

Descriptors: *Upflow blanket filters, *Anaerobic digestion, *Biomass, Upflow reactors, Wastewater treatment, Biological wastewater treatment, Industrial wastewater, Food processing industry, Sugars.

The loading capacities of an anaerobic wastewater treatment system are essentially dictated by the amount of active biomass that can be retained in the reactor, provided a sufficient contact between active biomass and waste organic can be assured. A new hybrid reactor, the upflow blanket filter (UBF), combines an open volume in the bottom two-thirds of the reactor for a sludge blanket and submerged plastic rings in the upper one-third of the reactor volume. This UBF reactor was operated at 27 C at loading rates varying from 5 to 51 g COD/L d with soluble sugar wastewater (2500 mg COD/L). Maximum removal rates of 34 g COD/L d and CH4 production rates of 7 vol/vol d were obtained. The biomass activity was about 1.2 g COD/g volatile suspended solids per day. Conversion (based on effluent soluble COD) was over 93% with loading rates up to 26 g COD/L d. At higher loading rates conversion decreased rapidly. The packing was very efficient in retaining biomass. The filter at the top of the UBF reactor has two advantages: space occupied by packing is not lost space for active biomass; and exploiting the floating capacity of the plastic rings is an inexpensive method to enhance biomass accumulation. The system should be cheaper than an anaerobic filter (less packing) and more likely to avoid the problems of channeling and plugging usually occurring in the bottom part of an anaerobic filter. (Moore-IVI)
W86-00889

ANAEROBIC PRETREATMENT REDUCES MILL COSTS, IMPROVES EFFLUENT QUALITY,
Buhrmann-Tetterode N.V., Roermond (Netherlands). Wastewater Dept.
L. H. A. Habets, and J. H. Knelissen.
Pulp and Paper, Vol. 59, No. 4, p 66-69, April, 1985. 2 Fig, 2 Tab, 2 Ref.

Descriptors: *Wastewater treatment, *Pulp and paper industry, *Industrial wastewater, *Anaerobic digestion, Biogas, Costs, Water treatment.

The Upflow Anaerobic Sludge Blanket (UASB) reactor has proven to be efficient and cost effective with paper mill waste of high organic content in several different installations in the Netherlands. Pilot studies of the UASB process were conducted at various different scales, and full-scale reactors are now operating at Oude Pekala (2,472 cu ft volume), Roermond (35,300 cu ft volume), and Celtona (24,700 cu ft volume). The UASB process will function with either granular or non-granular sludge; granular sludge permits higher loadings without loss of sludge in the effluent. At the Roermond plant, where the USAB reactor pretreats wastewater to reduce the loading of an activated sludge (aerobic) plant, a daily loading of 0.99 lb chemical oxygen demand (COD)/cu ft/day has been achieved without problems. COD removal has stabilized at 75% or better, and biochemical oxygen demand (BOD) removal is almost 90%. The reactor also produces 4,590 cu ft/hr of biogas containing 1-3% H2S, which is used to generate steam used in paper production. Each ton of COD removal yields 4.7 tons of 150 psi steam; excess

biogas is flared. Each pound of COD converted yields 0.1 lb of new granular sludge, which can be used to start up new USAB reactors. After more than a year of operation, the Roermond anaerobic treatment plant has proven to be more cost-effective than aerobic digestion, mainly because the quantity of energy in the biogas produced exceeds the energy consumed to power the process. (Rochester-IVI)
W86-00890

ION EXCHANGE POTENTIALLY EFFECTIVE IN REDUCING EFFLUENT FROM BLEACH PLANT,
Jordan (Edward C.) Co., Inc., Portland, ME.
J. H. Fitch, Jr.
Pulp and Paper, Vol. 59, No. 4, p 132-135, April, 1985. 1 Fig, 3 Tab.

Descriptors: *Ion exchange, *Bleaching wastes, *Industrial wastewater, *Pulp and paper industry, *Wastewater treatment, Resins, Zinc, Copper, Cadmium, Nickel, Metals.

Batch and pilot scale ion exchange resin treatment plants at the bleach plant at Billerud Uddeholm (Skoghall, Sweden) effectively remove color, chemical oxygen demand, chlorinated phenols, chlorinated guaiacols, and complexed metals. The treatment plants, which use a special resin supplied by Diamond Shamrock Corporation, do not remove resin, fatty acids, and phthalates. Inorganic chloride was removed initially, but the removal rate declined after the cycle started. Zinc and copper are removed through complexation and chelation. Cadmium and nickel appear to be removed effectively in the second column but are virtually untouched in the first. Chlorinated phenols and guaicols are removed more efficiently toward the end of the treatment cycle, probably because of loss of ionic character at low pH and the subsequent interaction with compounds previously removed. Extended contact time yielded no benefits; effective removal was lost rapidly, and a considerable number of pollutants passed through the columns. Although the startup period was long and troublesome, a full-scale treatment plant has been operating for almost 4 yr with high availability and without any real problems. The resin life (estimated at 6 mo) is shorter than it should be, which has increased operating costs of the plant because chemical costs increase as the resin ages. (Rochester-IVI)
W86-00892

ANAEROBIC WASTEWATER TREATMENT SYSTEM OPERATES AT VERY LOW COST,
Tampella Oy A.B., Tampere (Finland).
S. Rekunen.
Pulp and Paper, Vol. 59, No. 5, p 122-125, May 1985. 3 Fig, 3 Tab, 3 Ref.

Descriptors: *Pulp and paper industry, *Anaerobic digestion, *Industrial wastewater, Methane, Biogas, Operating costs, Costs, Activated sludge process.

The first stage of a methane-producing anaerobic reactor treatment system has begun operating at the Tampella paper mill at Anjala, Finland. This plant treats one third of the mill's total wastewater using reactors of 106,000 cu ft total volume; wastewater from the debarking plant, paper machines, and groundwood production is treated. The second stage of the plant will accomodate the rest of the total of 31 tons/day of biochemical oxygen demand (7-day) and 22 tons/day of suspended solids from the mill to achieve the regulatory goals of 6.6 tpd BOD and 8.8 tpd suspended solids. The process used was developed in the laboratory and in pilot studies conducted at the Anjala plant; it is named the TAMAN process. From the preclarifier, wastewater goes to the acid fermentation facility where micoorganisms break down organic matter to low-molecular-weight acids. In the acid stage, the homogenized wastewater is conducted to the methane stage, where bacteria break down the organic acids to methane and carbon dioxide. Some 4.8 cu ft of biogas is formed per pound of BOD reduction; it contains about 70% methane by volume. The pH of the wastewater is adjusted with Ca(OH)2 and nutrients such as urea and phosphoric acids can be added, if necessary. Sludge is collected in a separate tank from which it is conducted to a mechanical sludge processor. Sludge then can be burned in a fluidized bed boiler. Biogas is burned in a boiler or flared. For the Anjala site, the TAMAN process had construction costs similar to the activated sludge process, but the TAMAN process operating costs were only 10% of those for the same treatment capacity of activated sludge. In addition, the fuel value of the biogas is nearly $145,000 (US) per year. (Rochester-IVI)
W86-00893

5E. Ultimate Disposal Of Wastes

DISTRIBUTION OF ALUMINUM IN THE TISSUES OF THREE FISH SPECIES,
Northwestern State Univ. of Louisiana, Natchitoches. Dept. of Biological Sciences.
For primary bibliographic entry see Field 5C.
W86-00621

SIMULATED SOLUTE MOVEMENT IN WASTEWATER-PONDED SOIL,
Florida Univ., Gainesville. Dept. of Plant Pathology.
For primary bibliographic entry see Field 5D.
W86-00699

ENCLOSED VESSEL COMPOSTING BEGINS AT CAPE MAY COUNTY,
Cape May County (NJ) Municipal Utilities Authority.
W. W. Cathcart.
BioCycle, Vol. 26, No. 4, p 24-27, May-June, 1985. 5 Fig, 3 Tab.

Descriptors: *Composting, *Cape May County, *New Jersey, *Enclosed vessel composting, Sludge utilization, Costs, Wastewater treatment.

The composting system for treatment of domestic sewage sludge in Cape May County, New Jersey is described. The ABV/Purac system of in/vessel composting can be described as a vertical plug flow process. The composting vessel is fed from above by a spreader conveyer with material to be composted, and the composted material is discharged from the bottom by a power screw conveyor. Air is supplied at the bottom of the reactor and exhausted at the top. A General Electric Series Six programmable control handles the process control elements of the system. Temperature, carbon dioxide, status of the conveying system, status of the aeration system, weight of the input material, weight of the transferred material, weight of the output compost, and various warning alarms are continuously monitored. The facility includes a sludge container building, amendment storage building, operations building, maintenance building, BIO reactor, blower room, CURE reactor, and compost storage building. The development and construction costs were $9.1 million (US) and annual operating costs are $575,000. Dewatered municipal sludge of minimum 20% total sludge solids and sludge cake density of 50-60 pounds/cu ft is the input; output is a medium coarse to fine, friable compost of 10 mm maximum organic particle size and 60% maximum moisture. Volatile solids are reduced a minimum of 40% by the facility, which processes 12.1 tons per day in summer (tourist season) and 2.2 tons/day (off-season) when operating continuously. It is anticipated that some operating costs will be offset by revenues generated from sale of finished compost and by user fees charged for disposal of sludge. (Rochester-IVI)
W86-00713

LAND APPLICATION SYSTEMS FOR MUNICIPAL SLUDGE,
Nolte (George S.) and Associates, Sacramento, CA.
R. W. Crites.
BioCycle, Vol. 26, No. 4, p 32-34, May-June, 1984. 5 Tab, 11 Ref.

Descriptors: *Land application, *Sludge disposal, *Fertilizers, Cadmium, Nitrogen, Metals, Nutrients, Agriculture.

For all sizes of municipal treatment plants, about 25% of the sludge produced is land applied. Advances in design techniques over the past 10 yr allow the benefits of land application to be realized with minimal adverse impact. Examples of municipal systems in the USA with different agricultural end uses for sludge are Modesto, California (on city parks, landfills and farmland), Manteca, California (for corn and ryegrass), Seattle, Washington (on forest land), and Salem, Oregon (fields producing grains, grasses and silage corn, and Christmas tree farms). The design approach for land application is based on the utilization of sludge as a replacement for commercial fertilizer. The annual application is usually based on either the nitrogen or phosphorus needs of a particular crop. The loading rate for cadmium addition is then checked against the nutrient-based loading rate, and the lower of the two rates is used for design. In calculating the nitrogen available to plants, account must be taken of the relatively low availability of the organic nitrogen in sludge. Once the cadmium and nitrogen loading rates have been compared, and the lower of the two chosen, the land area required to dispose of the sludge is calculated by the formula: $F = W/S$, where F = field area, in acres, W = sludge quantity, in tons/yr, and S = the sludge loading rate, in tons/acre. Applying sludge to land provides considerable cost savings compared to incineration or landfilling. (Rochester-IVI)
W86-00714

SLUDGE MANAGEMENT: A RESEARCH UPDATE,
Weston (Roy F.), Inc., West Chester, PA.
Y. Hasit.
Biocycle, Vol. 26, No. 4, p 44-47, May-June, 1985. 80 Ref.

Descriptors: *Sludge, *Literature review, Research priorities, Polychlorinated biphenyls, Hexachlorocylohexane, Dieldrin, Heavy metals, Parasites, Stabilization, Composting, Sludge utilization.

A review of 1984 literature on sludge characteristics, solids concentration and conditioning, stabilization and inactivation, incineration, and ultimate disposal and utilization shows that most recent research has focused mainly on concerns and observations related to ultimate disposal of sludges, with few fundamental studies published on sludge properties, behavior and unit operations. Polychlorinated biphenyls, gamma-hexachlorocyclohexane, dieldrin, heavy metals, parasitic heleminth worms, and some mutagenic compounds have been reported from sludges. Sludge physical characteristics of importance to system design were examined in a few studies; centrifuges, filter presses, belt filters, and conditioning with polymers were among the topics studied. Stabilization and inactivation studies examined disinfection, pasteurization, lime stabilization, composting techniques, vermistabilization, and the occupational and public health aspects of composting. Operational problems of sludge incineration in Britain were attributed to variations in sludge quantity and quality, severe wear and tear due to inefficient grit removal, and equipment failures; in a Tennessee study, implementation of a fuel-efficient operating mode reduced annual fuel consumption by more than 40%. Land application of sludge has been studied recently from the points of view of heavy metal loading rates, effects of sludge on plant and animal life, the fate of organic pollutants and metals, accumulation of metals, and mined land reclamation. Other forms of sludge utilization studied were production of oil, fertilizer, energy, and bricks. (Rochester-IVI)
W86-00715

CONTROL OF METAL APPLICATION RATES FROM SEWAGE SLUDGE UTILIZATION IN AGRICULTURE,
Anglian Water Authority, Huntingdon (England). Directorate of Scientific Services.

For primary bibliographic entry see Field 5G.
W86-00854

PRIMARY/SECONDARY SLUDGE RECYCLED INTO VALUABLE AGRICULTURAL FERTILIZER,
M. J. Coleman.
Pulp and Paper, Vol. 59, No. 4, p 130-131, April, 1985. 1 Tab.

Descriptors: *Sludge disposal, *Fertilizer, *Land disposal, *Wisconsin, Agriculture, Vegetables, Nitrogen, Metals, Heavy metals, Cadmium, Zinc, Phosphorus, Potassium, Costs.

Consolidated Papers, of Wisconsin Rapids, Wisconsin, operates a program in which sludge from the company's Water Quality Center is distributed to local farmers for use on sandy, irrigated soils where a variety of vegetable crops (eg, green beans, potatoes, sweet corn, and beets) are grown. The paper mill yields about 270 wet tons/day of sludge, seven days a week; at present 2,000-3,000 acres are receiving sludge as a soil amendment. The application rate is 40-70 wet tons/acre, which translates into a nitrogen requirement of 100-200 lb/acre. The nitrogen content of the sludge is 1.8-2.5% on a dry solids basis; phosphorus as P (7.4 lb/dry ton) and potassium as K (3.6 lb/dry ton) in the sludge is low, but local soils are generally high in these elements in this part of Wisconsin. The sludge distribution program also includes monitoring of the receiving soils for nitrogen and solids, Cd, Zn, heavy metals, and priority pollutants, and monitoring local wells. Plants are tested for heavy metals and food quality. In spite of the costs associated with hauling the sludge, spreading it, and monitoring the effects, the program appears cost-effective when compared to landfilling and its associated siting problems and construction costs. Farmers receive fertilizer valued far above the nominal per acre cost charged by Consolidated Paper for its sludge. The program was introduced to farmers and the general public through a series of public meetings and agricultural show presentations. (Rochester-IVI)
W86-00891

5F. Water Treatment and Quality Alteration

EFFECT OF SULFITE DECHLORINATION ON THE ACCUMULATION OF WATERBORNE LEAD BY RAINBOW TROUT (SALMO GAIRDNERI),
Canada Centre for Inland Waters, Burlington (Ontario).
For primary bibliographic entry see Field 5A.
W86-00615

CONTAMINANT DEGRADATION IN WATER,
North Carolina State Univ. at Raleigh. Dept. of Chemical Engineering.
D. F. Ollis.
Environmental Science and Technology, Vol. 19, No 6, p 480-484, June, 1985. 6 Fig, 1 Tab, 32 Ref.

Descriptors: *Photocatalysis, *Water treatment, *Purification, Drinking water, Organic compounds, Photodegradation, Photochemical reactions, Halogenated hydrocarbons, Trichloroethylene, Perchloroethylene.

Heterogenous photocatalysis was examined as a possible tool for water purification. A slurry of 0.1 wt% TiO_2 powder in water was continuously recirculated through a reactor, a temperature-controlled bath, and a vessel that held chloride (or bromide) ion and reference electrodes for monitoring the progress of the reaction. The sample was injected through the septum of an orifice of the vessel. This system was used to study the degradation of chloroethanes, chloroethylenes and bromoethylenes, chlorobenzene, and chloroacetic acids in dilute aqueous solutions. The common water contaminants, trichloroethylene and perchloroethylene appear to be the strongest candidates for degradation by a potential photocatalytic process. (Baker-IVI)
W86-00660

NEW CONCEPTUAL FORMULATION FOR PREDICTING FILTER PERFORMANCE,
Indian Inst. of Tech., Kanpur. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W86-00661

REMOVAL OF ARSENIC FROM GEOTHERMAL FLUIDS BY ADSORPTIVE BUBBLE FLOTATION WITH COLLOIDAL FERRIC HYDROXIDE,
Hawaii Inst. of Geophysics, Honolulu.
For primary bibliographic entry see Field 5D.
W86-00662

DRINKING-WATER AND SANITATION PROJECTS: CRITERIA FOR RESOURCE ALLOCATION,
World Health Organization, Geneva (Switzerland). Div. of Environmental Health.
R. C. Ballance, and R. A. Gunn.
WHO Chronicle, Vol. 38, No. 6, p 243-248, 1984. 2 Fig.

Descriptors: *Public health, *Developing countries, *Sanitation, *Drinking water, Water supply, Water quality, Bacteria, Protozoa, Viruses.

Most of the diseases associated with inadequate water supplies and sanitation in developing countries are caused by bacteria, protozoa, viruses or worms. The contamination of water by chemicals is a less common factor. The prevention of any infectious disease requires the transmission cycle to be interrupted. Water and sanitation related diseases may have either complex or alternative transmission cycles. In complex transmission cycles, a period of development occurs in one or two specific intermediate hosts before the pathogen becomes infective to humans. Health considerations in project appraisal which are considered include community heath status, existing water supply, proposed water supply, existing sanitation, proposed sanitation, community health programs and staff, community perception of needs, community population characteristics, community education facilities, project communication support, media for health education in the community, community organization and resources, community development projects, and a national support system. (Baker-IVI)
W86-00669

MUTAGENICITY ASSESSMENT OF DIFFERENT DRINKING WATER SUPPLIES BEFORE AND AFTER TREATMENTS,
Perugia Univ. (Italy). Cattedra di Igiene.
For primary bibliographic entry see Field 5A.
W86-00690

FACTORS INFLUENCING THE HIGH CONTENT OF BROMINATED TRIHALOMETHANES IN BARCELONA'S WATER SUPPLY (SPAIN),
Sociedad General de Aguas de Barcelona (Spain).
For primary bibliographic entry see Field 5B.
W86-00727

POTENTIAL USE OF ENZYMES FOR REMOVAL OF AROMATIC COMPOUNDS FROM WATER,
S. W. Maloney, J. Manem, J. Mallevialle, and F. Fiessinger.
Water, Science and Technology, Vol. 17, No. 2/3, p 273-278, 1985. 1 Fig, 2 Tab, 12 Ref.

Descriptors: *Water treatment, *Enzymes, *Aromatic compounds, Phenols, Chlorinated phenols, Peroxidase-peroxide system, Monochlorophenol, Dichlorophenol, Pentachlorophenol.

The removal of aromatic compounds by the peroxidase - hydrogen peroxide system was studied at low levels which might be encountered in surface waters which receive some industrial discharge. Three compounds, mono-, di-, and pentachlorophenol, are used as model aromatic compounds. The treatment process is characterized both in terms of specific compound removal and removal of its reaction products. The enzyme system is effective in eliminating chlorinated phenols at low levels from drinking water supplies, but does not remove their products from the water. Further work is necessary to determine if these by-products present a potential risk for the human health and if they are removed in other unit processes. The enzymatic procedure may offer an alternative to the standard treatments, for example for sporadic taste and odor problems associated with chlorinated phenols. (Moore-IVI)
W86-00753

UV INACTIVATION OF PATHOGENIC AND INDICATOR MICROORGANISMS,
North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
For primary bibliographic entry see Field 5D.
W86-00774

ELIMINATION OF VIRUSES AND INDICATOR BACTERIA AT EACH STEP OF TREATMENT DURING PREPARATION OF DRINKING WATER AT SEVEN WATER TREATMENT PLANTS,
Institut Armand-Frappier, Laval (Quebec). Centre de Recherche en Virologie.
P. Payment, M. Trudel, and R. Plante.
Applied and Environmental Microbiology, Vol. 49, No. 6, p 1418-1428, June, 1985. 6 Fig, 11 Tab, 25 Ref.

Descriptors: *Drinking water, *Water treatment, *Viruses, *Bacteria, Bioindicators, Disinfection, Enteroviruses, Raw water, Coliform, Chlorination, Sedimentation, Filtration, Ozonation.

Seven drinking water treatment plants were sampled twice a month for 12 months to evaluate the removal of indicator bacteria and cytopathogenic enteric viruses. Samples were obtained at each level of treatment: raw water, postchlorination, postsedimentation, postfiltration, postozonation, and finished (tap) water. Raw water quality was usually poor, with total coliform counts exceeding 105 to 106 CFU/liter and the average virus count in raw water of 3.3 most probable number of cytopathogenic units (MPNCU)/liter; several samples contained more than 100 MPNCU/liter. All plants distributed finished water that was essentially free of indicator bacteria as judged by analysis of 1 liter for total coliforms, fecal coliforms, fecal streptococci, coagulase-positive staphylococci, and Pseudomonas aeruginosa. The total plate counts at 20 and 35 C were also evaluated as a measure of the total microbial population and were usually very low. Viruses were detected in 7% (11 of 155) of the finished water samples (1,000 liters) at an average density of 0.0006 MPNCU/liter the highest virus density measured being 0.02 MPNCU/liter. The average cumulative virus reduction was 95.15% after sedimentation and 99.97% after filtration and did not significantly decrease after ozonation or final chlorination. The viruses isolated from treated waters were all enteroviruses: poliovirus types 1, 2, and 3, coxsackievirus types B3, B4, and B5 echovirus type 7, and untyped picornaviruses. (Author's abstract)
W86-00775

ASSESSMENT OF WATER UTILITY INFORMATION SYSTEMS AND THEIR USE OF COMPUTERS,
Cincinnati Univ., OH. Dept. of Mechanical and Industrial Engineering.
R. L. Shell, and N. A. Damachi.
Water Resources Bulletin, Vol. 21, No. 2, p 323-330, April, 1985. 1 Fig, 9 Tab, 9 Ref.

Descriptors: *Utilities, *Water conveyance, *Water treatment, *Computers, Ohio, Indiana, Kentucky, Recordkeeping, Maintenance, Inspection, Water storage, Water loss, Water metering.

A direct mail survey of all water utilities serving populations of 2,000 or more in the tri-state area - Ohio, Indiana, and Kentucky was conducted, and the following were determined: utility profile information, e.g., public/private ownership, age, number of accounts, etc.; an assessment of the degree of computerization presently in place to perform various functions; and an assessment of any plans that the utilities may have for future computerization. To analyze the data, an index of computerization was defined as the number of departments or major areas of each utility that presently have some computerization. Departments and major areas included: water pumping, treatment, storage and distribution; metering and billing; accounting and personnel records; inspection and maintenance; and utility operations. Discriminant analysis revealed strong significant differences between utilities that plan to use computers and those that do not. There is a rather limited use of computers in the tri-state area. Fifty-one percent of the water utilities in Kentucky do not use computers at all in their operations. In Ohio and Indiana the figures are 39% and 51%. Many utilities use computers only for billing. The major form of recordkeeping in water utilities in the tri-state area is manual. Water loss in many systems appears to be a problem in Kentucky. Enormous potential exists in small and medium sized utilities for computerization to improve operational efficiency. (Moore-IVI)
W86-00795

TRENDS IN DRINKING WATER TREATMENT THE SHAPE OF THINGS TO COME,
Metcalf and Eddy of New York, NY.
G. P. Fulton.
Public Works, Vol. 116, No. 6, p 80-83, 138 and 140, June, 1985.

Descriptors: *Drinking water, *Water treatment, *Future planning, Modernization, Filtration, Organics removal, Disinfection, Chlorination, Measuring instruments, Costs, Manpower.

Treatment systems of the future will be different from older systems as water purveyors use innovative techniques to achieve solutions to particular water quality problems at particular sites. Earlier designs employed a 'worst case' solution, which tended to introduce redundancy of equipment and high cost. Future systems will control intermittent quality problems (eg, giardiasis, viral epidemics, accidental waste spills, leaching from waste dumps, and pesticide contamination) with approaches designed for the conditions at a given locality. The preeminent changes likely to occur in surface water treatment for drinking should be in filtration, organics removal, and disinfection. Both operational and equipment innovations will be employed to improve filtration results. In the interim period before final regulations for organics are established, primary emphasis will probably be on multi-purpose measures that moderate potential organic contamination problems, including aeration or air stripping, air flotation, granulated organic carbon filter media, and ozonation. Accepted disinfection alternatives to conventional chlorination are chloramines, chlorine dioxide, and ozone. Monitoring and control systems are becoming more complicated, with greater reliance on computers for both data recording and operations; the greatest changes will occur in instrumentation. Staffs at treatment plants will become smaller, but more highly trained, as equipment becomes more sophisticated. Future plants wil be customized designs, each intended to cope with particular source water quality features. Use of multi-purpose unit process elements will be more common to both optimize performance and reduce treatment costs. (Rochester-IVI)
W86-00805

UTILITY BATTLES IRON AND MANGANESE,
Hibbing Public Utilities Commission, MN.
R. P. Richards, and S. N. Foellmi.
Public Works, Vol. 116, No. 6, p 91-95, June, 1985. 4 Fig, 1 Tab.

Descriptors: *Water treatment, *Drinking water, *Iron removal, *Manganese removal, *Hibbing, *Minnesota, Pilot plant studies, Water supply, Municipal water, Oxidation, Chlorine, Potassium permanganate.

Computer analysis and a pilot plant study were employed to develop an increased capacity and improved water quality in a supply system deriving all its water from wells. The water-supply system, located in Hibbing, in the heart of the northeastern Minnesota iron mining district, had a history of problems with high iron and manganese (exceeding Environmental Protection Agency (EPA) Secondary standards in flow from all its wells but one). In redesigning the system, four alternatives were examined in which water from the Scranton (high quality water) wells would be pumped to the distribution system, where it would be blended with effluent from a treatment plant that would process the water from the other wells. Chemical oxidation with chlorine and potassium permanganate and continuously regenerated manganese greensand pressure filters was shown through analysis to be the most cost-effective treatment process. A pilot plant test showed that this treatment method could reduce the iron and manganese contents below EPA limits; the pilot test also provided filter loading rate, filter run time, maximum head loss across the filter, and the chemical feed dosage data that were useful in designing the full-scale plant. The water treatment plant was placed on line in early 1984, and the flow rate has averaged 1.9 million gallons/day (mgd), with a peak production of 3.2 mgd. Finished water has consistently met all regulatory agency standards. The pilot plant work provided an excellent projection of the full-scale plant chemical treatment requirements. Treatment cost for iron and manganese removal (chlorine and potassium permanganate) has been about $24/million gallons. (Rochester-IVI)
W86-00807

CITY IMPLEMENTS TRIHALOMETHANE CONTROL PROGRAM,
Neel-Schaffer, Inc., Jackson, MS.
J. G. Sigman, and W. M. Ashley.
Public Works, Vol. 116, No. 6, p 98-99, June, 1985. 1 Fig, 2 Tab.

Descriptors: *Trihalomethanes, *Water treatment, *Jackson, *Mississippi, *Drinking water, Source of pollutants, Chlorination, Water pollution control, Filtration, Sedimentation.

The city of Jackson, Mississippi has successfully initiated an ammoniation program to bring trihalomethane (THM) levels down to meet National Interim Primary Drinking Water Regulations. In 1975, the total THM in water in Jackson was 334 ppb, primarily as a result of increasing urbanization along the banks of the Pearl River upstream from where the treatment plant withdraws source water. A variation to the usual chloramination design that was used here was carrying a free chlorine residual through part of the treatment process, which was done in response to the following local conditions: (1) onsite storage at the plant is limited, with only 6-10 hr between flash mixing and finished water pumping, (2) the Pearl River exhibits great fluctuations in bacterial quality, (3) the 28 rapid sand filters at the plant are exposed, and (4) it was decided to change the disinfection systems from pre- and post- chlorination to mid-point (after sedimentation and before filtration) chlorination and post (just prior to finished water pumping) ammoniation. Pre-start-up monitoring showed that in every quarterly sample from January 1981 through August 1983, the 100-ppb limitation for total THMs was exceeded, with an average typically around 200 ppb, but running to as high as 450 ppb. In the quarters since startup, there has been a 70% reduction in total THMs, with the average quarterly value at six sample points being around 84 ppb. Consumers report that as a result of elimination of the free chlorine residual the water tastes better. (Rochester-IVI)
W86-00808

REMOVING VOC FROM GROUNDWATER; PILOT, SCALE-UP, AND OPERATING EXPERIENCE,
CH2M Hill, Inc., Corvallis, OR.
W. D. Byers, and C. M. Morton.
Environmental Progress, Vol. 4, No. 2, p 112-118, May, 1985. 9 Fig, 4 Tab, 14 Ref.

Descriptors: *Volatile organic compounds, *Water treatment, *Tacoma, *Washington, *Groundwater contamination, *Air stripping, Tetrachloroethane, Dichloroethylene, Trichloroethylene, Perchloroethylene, Chlorinated hydrocarbons, Organic compounds.

A pilot study of packed tower air stripping, followed by observations on performance of a full-scale facility, demonstrated the viability and cost-effectiveness of this technique for removal of volatile organic compounds (VOCs) from well water. The initial analysis and subsequent pilot study were conducted in response to the discovery of up to 300 micro-g/l of 1,1,2,2-tetrachloroethane, 100 micro-g/l of trans-1,2-dichloroethylene, 130 micro-g/l of trichloroethylene, and 5 micro-g/l of perchloroethylene in well water in Tacoma, Washington. The pilot study was conducted in two series: air and water at ambient temperature (20 C) and with total VOC concentration in the influent of about 700 micro-g/l, and air and water chilled to 6 C, with a total VOC concentration of about 1,500 micro-g/l. The Onda method of predicting mass transfer coefficients for the scaled-up version of the plant was used because the present study and others had indicated good agreement between the Onda model and data taken on different types of packing, column sizes, and different compounds. The full-scale facility consisted of five towers, 12 ft in diameter, packed to a depth of 20 ft with 10-inch polypropylene saddles. Water flow per tower was 700 gallons/minute; running in parallel the system could handle 3,500 gallons/minute. The towers have consistently removed 94-98% of the influent 1,1,2,2-tetrachloroethane, with an average 95.5% removal. Other compounds were essentially undetected in the effluent during normal operation, indicating overall VOC removal efficiencies in excess of 98%. The installed cost of the treatment system was approximately $750,000. (Rochester-IVI)
W86-00816

PACKED TOWER AERATION STRIPS TRICHLOROETHYLENE FROM GROUNDWATER,
Air Force Engineering and Services Center, Tyndall AFB, FL.
R. L. Gross, and S. G. TerMaath.
Environmental Progress, Vol. 4, No. 2, p 119-124, May, 1985. 10 Fig, 3 Tab, 15 Ref.

Descriptors: *Water treatment, *Groundwater contamination, *Air stripping, *Trichloroethylene, Chlorinated hydrocarbons, Granulated activated carbon, Operating costs, Capital costs, Aeration.

Laboratory determination of Henry's constant and mathematical estimation of appropriate parameters were used directly in the design of a full-scale packed tower air stripper using 16 mm Pall rings to remove trichloroethylene (50-8,000 micro-g/l) from water. The prototype packed tower system used two towers that could be operated either in series or in parallel. Performance generally exceeded design goals, with single tower removal rates of 86-98% and series operation removal rates of 96-99.9%. Higher volumetric air/water (G/L) ratio gave better removal up to a value of 18, with little improvement for G/L above that value. Treatment capacity for the prototype system is 4,540 liter/min in parallel or 2,270 liter/min in series. An unexpected bacterial growth occurred in the air strippers during the first few months of operation; it involved eight different, non-pathogenic organisms, and the accumulation was sufficient to increase head loss to a point where operations had to be stopped and the packing cleaned. Periodic calcium hypochlorite chlorination was insufficient to prevent recurrence of the growth, but continuous calcium hypochlorite chlorination was successful. Comparison of the air stripping tower system with granular activated carbon system previously used to treat the same waste stream showed that both capital and operating costs for the air stripping method were very much lower, with a treatment

cost per 1,000 liters of $0.26 versus $0.03, respectively. (Rochester-IVI)
W86-00817

REMOVAL OF NATURALLY OCCURRING COMPOUNDS BY COAGULATION AND SEDIMENTATION,
B. A. Dempsey.
CRC Critical Reviews in Environmental Control, Vol. 14, No. 4, p 311-331. 10 Fig, 145 Ref.

Descriptors: *Water treatment, *Coagulation, *Sedimentation, *Aluminum, Chemical reactions, Double-layer compression, Charge neutralization, Adsorption, Heterocoagulation, Polyelectrolytes, Turbidity, Color.

Mechanisms for destabilization of contaminants during the process of coagulation, the chemistry of aluminum in water, and the removal of contaminants by coagulation, are reviewed including models of the coagulation process. The terms coagulation and flocculation have been used in the literature in ways that lead to semantic confusion. Destabilization of particles in coagulation can occur by at least four mechanisms: (1) double-layer compression, (2) charge neutralization, (3) formation of a sweep floc leading to adsorption or heterocoagulation of the contaminant, and (4) bridging by high molecular-weight polyelectrolytes. Conventional water treatment is oriented toward removal of turbidity (the most common surrogate parameter for particles) and sometimes color. Materials for which removal techniques have been developed include clays, microorganisms, asbestos, natural organic materials, inorganic solutes, and trace organic substances. Models of the coagulation process that apply to the techniques employed for coagulation of contaminants include particle numbers and size distributions, integral analysis of water plant performance, micromix theory, and models of coagulant reactions. (Rochester-IVI)
W86-00855

DESTROYING PYROGENS IN WATER,
Electricity Council Research Centre, Capenhurst (England).
R. Barker, S. Poole, and F. M. Taylor.
Effluent and Water Treatment Journal, Vol. 25, No. 4, p 119-124, April, 1985. 2 Fig, 6 Tab, 12 Ref.

Descriptors: *Pyrogens, *Water treatment, *Ozone, *Bacterial toxins, *Toxins, *Ultraviolet radiation, Escherichia, Shigella, Public health.

The UV/ozone method for removing pyrogens was tested using Escherichia coli endotoxin as the test pyrogen. An apparatus consisting of a flow-through ozonizer, followed by a 5-liter reaction vessel for exposure to UV (254 nanometer) light from a low-pressure mercury lamp, rendered dilute solutions of E. coli endotoxin pyrogen-free. Pyrogen presence or absence was determined by the Limulus amoebocyte lysate test. Both UV light and ozone were essential for the efficiency of the process. The rate of destruction of pyrogen was (1) only slightly dependent on the pyrogen concentration, (2) independent of the nominal concentration of ozone in the aqueous phase, above 1 ppm, and (3) increased as the UV irradiation intensity was increased. The presence of 0.9% w/v of sodium chloride in the solution did not affect the reactions taking place. In a typical experiment it took 30 min to reduce 100 nanogram (ng)/ml E. coli endotoxin to below the lysate sensitivity of 0.4 ng/ml. Solutions of 20, 40, and 200 ng/ml of Shigella dysenteriae were subjected to 1 hr of UV/ozone treatment, and all three passed the 'Test for Pyrogens' using rabbits. (Rochester-IVI)
W86-00870

OCCURRENCE OF CHLORINATED POLYNUCLEAR AROMATIC HYDROCARBONS IN TAP WATER,
National Inst. for Environmental Studies, Tsukuba (Japan). Div. of Chemistry and Physics.
For primary bibliographic entry see Field 5B.
W86-00895

5G. Water Quality Control

SECURITY OF GROUNDWATER CATCHMENTS NEAR RIVERS; CHARTS TO DETERMINE THE VARIATION IN THE REPLENISHMENT FLOW (SURETE DES CAPTAGES D'EAU SOUTERRAINE A PROXIMITE DES RIVIERES; ABAQUES POUR DETERMINER L'EVOLUTION DU DEBIT DE REALIMENTATION FLOW),
Laboratoire National d'Hydraulique, Chatou (France).
For primary bibliographic entry see Field 2F.
W86-00656

RE-EVALUATING THE EXTENT OF GROUNDWATER CONTAMINATION,
National Water Well Association, Worthington, OH.
J. H. Lehr.
Water and Pollution Control, Vol. 123, No. 3, p 16-18, May/June, 1985.

Descriptors: *Water management, *Groundwater supply, *Water supply development, *Groundwater pollution, Management, Decision making, Water resources development, Planning, Evaluating.

Through a series of assumptions, it is concluded that, even with groundwater pollution occurring, we have yet to pollute even 1% of the total groundwater supply. The initiation of new sources of groundwater pollution can be eliminated within the next 10 years which will put an end to ill conceived practices that brought about the problem in the first place. The existing contamination plumes will not have moved much further or polluted much more by then than they already have. The odds are that we will end up with 98% of the groundwater still unpolluted by the end of this century. Practices which have led to the path of wanton wastefulness are reviewed. The first course of action should be to implement some management options that will work. Also needed is an evaluation of where a lack of efficiency exists in using water and these practices should be eliminated. An evaluation of inefficient irrigation practices is one step. The conjunctive use of surface and groundwater can help reduce the impact of localized droughts. Perhaps one of the most neglected management options is that of artificial recharge. There is no loss to evaporation as with a surface reservoir and many sources of water, which normally flow out of the watershed, can be recycled and saved right there. (Baker-IVI)
W86-00686

PROTECTING WATER QUALITY IN THE MIDWEST: IMPACT ON TIMBER HARVESTING COSTS,
Minnesota Univ., St. Paul. Dept. of Forest Resources.
For primary bibliographic entry see Field 5D.
W86-00720

ENVIRONMENTAL AUDIT. II. APPLICATION TO STREAM NETWORK DESIGN,
Minnesota Univ., St. Paul. Dept. of Forest Resources.
For primary bibliographic entry see Field 7A.
W86-00723

STATUS OF NONPOINT SOURCE POLLUTION: ITS NATURE, EXTENT AND CONTROL,
Battelle Columbus Div., OH.
For primary bibliographic entry see Field 5B.
W86-00779

URBAN RUNOFF: POLLUTION SOURCES, CONTROL, AND TREATMENT,
Environmental Protection Agency, Edison, NJ. Storm and Combined Sewer Technology Branch.
R. Field.
Water Resources Bulletin, Vol. 21, No. 2, p 197-206, April, 1985. 2 Fig, 2 Tab, 101 Ref.

Descriptors: *Urban runoff, *Water pollution control, Storm wastewater, Water management, Land use, Drainage, Water storage, Wastewater treatment, Sewer systems, Water reuse, Water pollution sources.

This paper reviews progress on urban stormwater management and pollution control, with emphasis on non- and low-structurally intensive techniques along with the total system approach encompassing control-treatment. Many of the U.S. Environmental Protection Agency's demonstration-evaluation projects are presented to exemplify: Land Management Techniques, i.e., land use planning, best use of natural drainage, dual use of retention and drainage facilities required for flood control designed concurrently or retrofitted for pollution control, porous pavement, surface sanitation, and chemical use control; Collection Systems Control, i.e., catchbasin cleaning, flow regulators (including swirl and helical devices), and the new concepts of elimination or reduction of unauthorized cross-connections, in-channel/conduit storage and/or other forms of storage for bleed-back to existing treatment plants; Storage including in-receiving water storage; Treatment, i.e., physical/chemical, disinfection, and a treatment-control planning and design guidebook; Sludge and Solids Residue from Treatment; and Integrated Systems, i.e, storage/treatment, dual-use wet-weather flow/dry-weather flow facilities, and reuse of stormwater for nonpotable purposes. Recommendations for the future in the areas of: control based on receiving water impacts, toxics characterization and their control, sewer system cross-connections, integrated stormwater management, and institutional/sociological/economic conflicts are also presented. (Author's abstract)
W86-00781

FARMERS' ATTITUDES TOWARD NONPOINT POLLUTION CONTROL AND PARTICIPATION IN COST-SHARE PROGRAMS,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Agricultural Economics.
W. R. Kerns, and R. A. Kramer.
Water Resources Bulletin, Vol. 21, No. 2, p 207-215, April, 1985. 6 Tab, 14 Ref.

Descriptors: *Nonpoint pollution sources, *Water pollution control, *Attitudes, *Farms, *Cost sharing, Virginia, Loans, Taxes, Soil loss, Soil erosion, Public participation.

The success of government programs to control nonpoint source pollution depends upon attitudes toward those programs and the availability of technical and financial assistance. Applicants for the Rural Clean Water Program cost-share funding in Virginia possess different personal and operational characteristics than do nonapplicants. Factors associated with participation in the Rural Clean Water Program differed from those associated with the more traditional soil conservation programs. Discriminant analysis was used to differentiate between other farmers who may become applicants and nonapplicants. Farmers' attitudes toward various policy options for inducing implementation of nonpoint source management practices varied greatly. Farmers were most favorable to cost sharing, low-interest loans and tax credits, and least favorable to a soil loss tax. They were either very favorably or very unfavorably inclined toward cross-compliance between pollution control and other agricultural programs. (Author's abstract)
W86-00782

WATERSHED PLANNING FOR ACID MINE DRAINAGE ABATEMENT,
Georgia Univ., Athens. School of Environmental Design.
For primary bibliographic entry see Field 4D.
W86-00787

IN-LAKE WATER QUALITY MANAGEMENT PLAN FOR A RECREATIONAL LAKE IN CENTRAL ILLINOIS,
Illinois State Water Survey, Peoria. Water Quality Section.

R. K. Raman, and R. L. Evans.
Water Resources Bulletin, Vol. 21, No. 2, p 315-321, April, 1985. 2 Fig, 3 Tab, 10 Ref.

Descriptors: *Water quality management, *Lake restoration, *Johnson Sauk Trail Lake, *Illinois, Eutrophication, Destratification, Algal control, Copper sulfate, Potassium permanganate.

Johnson Sauk Trail Lake (Illinois) remains highly eutrophic, even though the watershed has long been returned to an undisturbed condition with permanent vegetative cover and with little or no land disturbance in the watershed. Internal regeneration of nutrients has been identified as the major source of nutrients to the lake. Lake destratification, selective harvesting and removal of weeds, and control of algal blooms using chelated copper sulfate application followed by potassium permanganate application have all been chosen as management techniques for improving water quality conditions in the lake. These in-lake techniques are considered not as palliative measures, but as necessary tools in enhancing the lake's water quality characteristics. (Author's abstract)
W86-00794

ENVIRONMENTAL PROTECTION IN THE REPUBLIC OF IRELAND,
Trinity Coll., Dublin (Ireland). Environmental Sciences Unit.
N. F. Gray.
Effluent and Water Treatment Journal, Vol. 25, No. 3, p 83-89, March, 1985. 1 Tab, 11 Ref, 2 Append.

Descriptors: *Environmental protection, *Ireland, *Legislation, Protection, Water pollution control, Resources management, Water management.

Water quality maintenance laws and agencies in the Republic of Ireland were evaluated. Unlike many other European countries, no single body is responsible for, or coordinates, the management of water resources. The system is local authority-based, and relies heavily on state and semi-state bodies to carry out a number of important functions. Before the implementation of the Local Government (Water Pollution) Act of 1977, three pieces of legislation, the Public Health Act of 1979, the Fisheries (Consolidation) Act of 1959, and the Local Government (Planning and Development) Acts of 1963 and 1976, were widely used in the protection of waters and public supplies. The Water Pollution Act attempts to centralize the responsibility for water resource management with local authorities, but numerous other organizations still retain various statutory responsibilties in relation to water management and pollution control. The Water Pollution Act obliges local authorities to monitor and analyze discharges and receiving water, but few are able to do so without relying on other agencies for laboratory services. Many other organizations carry on monitoring programs; at present the data are not coordinated, but eventually a catchment area-based data collection system will be instituted by local authorities. The Water Pollution Act was also designed to satisfy the legislative requirements of the European Economic Community directives, which it has successfully done to date. The Water Pollution Act is clearly adequate to protect Ireland's water resources, and overlapping sections of other acts should be repealed to eliminate duplication of responsibilities and legislative confusion. A more coordinated, catchment-based water management system, with complete control of all water functions, would appear to be the most cost-effective way for efficient water resource management, particularly pollution control. (Rochester-IVI)
W86-00813

INNOVATIVE WATER QUALITY-BASED PERMITTING: A POLICY PERSPECTIVE,
Skylonda Group, Inc., Menlo Park, CA.
D. Downing, and S. Sessions.
Journal of the Water Pollution Control Federation, Vol. 57, No. 5, p 358-365, May, 1985. 22 Ref.

Descriptors: *Permits, *Water quality, Water pollution control, Costs, Nonpoint pollution sources, Water pollution sources, Administration, Environmental effects.

The Water Innovations Project (U.S. Environmental Protection Agency, Office of Policy, Planning, and Evaluation) examined two generic types of permitting innovations: those that make greater use of the capacity of the water body to assimilate wastes, and those that encourage more efficient allocation of a given total wasteload through trading mechanisms. Innovations in the first group are seasonal permits, variable permits, seasonal standard and site-specific standards. Interplant source trades, point/nonpoint source trades, and banking comprise the second group. Cost effects, water quality eligible pollutants, and administrative issues associated with these permitting innovations were studied. All innovations would apply only where controls beyond technology-based standards are required to attain water quality standards. The innovations are most directly applicable to conventional pollutants and nutrients, not for toxics. Based on case analysis the innovations appear to provide large cost savings while protecting water quality. Administrative safeguards, such as criteria for particular pollutants when innovative permitting is used, or restrictions on situations in which innovative permitting can be employed, are needed to protect water quality and program integrity, while avoiding excessive administrative burdens. Analysis of case studies actual experience in states where these innovations are already in use indicated substantial cost savings, few if any adverse environmental effects, and manageable administrative burdens. In some states, innovative permitting broke regulatory impasses and led to earlier attainment of water quality standards than would otherwise have occurred. (Rochester-IVI)
W86-00839

CONTROL OF METAL APPLICATION RATES FROM SEWAGE SLUDGE UTILIZATION IN AGRICULTURE,
Anglian Water Authority, Huntingdon (England). Directorate of Scientific Services.
P. J. Matthews.
CRC Critical Reviews in Environmental Control, Vol. 14, No. 3, p 199-250. 4 Fig, 19 Tab, 166 Ref.

Descriptors: *Sludge disposal, *Metals, *Agriculture, *Environmental protection, Water pollution control, Fertilizers, Heavy metals, Arsenic, Boron, Cadmium, Chromium, Cobalt, Copper, Lead, Manganese, Mercury, Molybdenum, Nickel, Selenium, Zinc, Soil, Economic aspects.

Potentially toxic metals in sewage sludge and their chemistry in the sludge medium, potentially toxic metals in normal and sludged soils, chemical controls on metal availability, and the effect of potentially toxic metals on crops and the agricultural consequences of their presence, are reviewed, and recommendations for controlling the application of sludge to land are presented. Chemical elements of interest in this field are arsenic, boron, cadmium, chromium, cobalt, copper, lead, manganese, mercury, molybdenum, nickel, selenium, and zinc. A survey of sludge disposal in the United Kingdom in 1980-81 showed that disposal of sludge on general arable land and marine dispersal accounted for more than half of the ultimate disposal of sewage sludge. The use of sewage as a fertilizer should be controlled so as to meet the following objectives: (1) avoid spread of human, animal, and plant diseases, (2) avoid public nuisance, particularly odors, (3) avoid harm to crop quality and yield resulting from soil contamination, (4) protect surface and ground waters, and (5) provide an acceptable and useful service to farmers. Application of metals to agricultural land may be controlled by limiting their concentrations in sludge, limiting their concentrations in sludge-amended soils, and limiting the rate of accumulation of metals in soil. Approaches used in deriving guidelines differ according to whether regional soils are acidic or alkaline. Industrial effluent control is an important element of controlling sludge metal concentrations; presence of industrial metals may be a factor in determining whether fertilization is an acceptable use for a particular sludge. At present, costs of removing metals from sewage sludge are prohibitive when compared to the value of the isolated metals. If the prices of metals rise, industrial discharge may decline, reducing the metal content in the sludge, thus making metal recovery from sludge less, rather than more, economic. (Rochester-IVI)
W86-00854

ALTERNATIVE APPROACHES TO ACID RAIN CONTROL,
For primary bibliographic entry see Field 6E.
W86-00867

DISSOLVED OXYGEN CONCENTRATIONS IN FLORIDA'S HUMIC-COLORED WATERS AND WATER QUALITY STANDARD IMPLICATIONS,
Florida Inst. of Tech., Melbourne. Dept. of Environmental Sciences and Engineering.
T. V. Belanger, F. E. Dierberg, and J. Roberts.
Environmental Chemistry, Vol. 48, No. 2, p 107-119, 1985. 6 Fig, 5 Tab, 15 Ref.

Descriptors: *Water quality standards, *Florida, *Dissolved oxygen, *Humic-colored waters, Swamps, Lakes, Streams, Humic waters, Colored waters.

The Florida Department of Environmental Regulation (DER) has established detailed dissolved oxygen standards for the various classes of surface water in the state. According to these standards, Class III Waters (recreation) should maintain dissolved oxygen levels above 5 mg/L. Many natural humic-colored aquatic systems (lakes, swamps, and streams) rarely meet the established 5 mg/L criteria. Four sites in east and central Florida having differing degrees of humic color were investigated three or four times in one year. The 24-hr average oxygen levels at the sites varied form a summer low of 1.2 mg/L in a natural drainage marsh, to 6.0 mg/l in a man-made drainage structure. The systems are generally very undersaturated with respect to oxygen. It is believed that these conditions are natural and do not result from organic pollution. In view of this data and a brief review of the literature, it seems that the 5.0 mg/L dissolved oxygen standard for these and similar aquatic systems is unrealistic. A better approach would be to set standards based on the continued determination of the uniqueness of each system. (Moore-IVI)
W86-00901

6. WATER RESOURCES PLANNING

6A. Techniques Of Planning

ADDRESSING SOCIAL AND ENVIRONMENTAL ISSUES IN WATER RESOURCES PLANNING AND MANAGEMENT,
Florida Univ., Gainesville. Dept. of Environmental Engineering Sciences.
W. Viessman, Jr.
Water Resources Bulletin, Vol. 21, No. 2, p 311-314, April, 1985. 2 Ref.

Descriptors: *Water resources development, *Planning, *Social aspects, *Environmental effects, Education, Public information, Management, Problem solving, Decision making.

Social and environmental goals and objectives are continually changing and often are difficult to quantify. Understanding social goals and objectives and incorporating them in water resources planning, management, education and engineering processes are keys to solving many current and emerging water resources problems. It will be necessary to instruct students, lay-persons and professionals in the importance of their involvement in the areas of goal-setting and policy-structuring, and on how to function effectively in a political-social-natural environment. The issue is how to get information on viable alternatives to decision making bodies relative to the issues with which they are concerned. The objective is to present well-informed choices, ones that are socially acceptable, technically sound and economically effi-

cient. Problem solving should be taught in the context of constraining influences, both natural and social. Findings should be presented so that those without technical expertise can understand and use them. Stronger interactions between practicing professional and the faculties of universities may lead to such objectives. Professionals must have a broad perception of the world outside their area. (Moore-IVI)
W86-00793

6B. Evaluation Process

DRINKING-WATER AND SANITATION PROJECTS: CRITERIA FOR RESOURCE ALLOCATION,
World Health Organization, Geneva (Switzerland). Div. of Environmental Health.
For primary bibliographic entry see Field 5F.
W86-00669

POLLUTANT RUNOFF MODELS: SELECTION AND USE IN DECISION MAKING,
Duke Univ., Durham, NC. School of Forestry and Environmental Studies.
For primary bibliographic entry see Field 5B.
W86-00780

SIMULATION AND DECISIONMAKING: THE PLATTE RIVER BASIN IN NEBRASKA,
Nebraska Univ.-Lincoln. Dept. of Civil Engineering.
M. W. Gilliland, L. Becker, R. Cady, J. Gabig, and J. Gilley.
Water Resources Bulletin, Vol. 21, No. 2, p 281-290, April, 1985. 5 Fig, 4 Tab, 7 Ref.

Descriptors: *Water management, *Water allocation, *Platte River Basin, *Nebraska, *Simulation, *Decision making, Computer models, Water supply, Water quality, Environmental effects, Economic aspects, Instream flow, Water diversion, Agriculture, Wildlife.

Substantial conflict exists over water management and allocation in the Platte River Basin of Nebraksa. An interdisciplinary computer simulation model, representing the water quantity, water quality, environmental, and economic dimensions of the conflict, was developed in order to analyze the tradeoffs among allocation scenarios. Most importantly, decisionmakers and interest groups were involved in model development. Simulation results for a base case and two scenarios are presented. One scenario favors potection of instream flow for wildlife; the other favors waters diversions for agriculture. Impacts of the instream flow scenario, as measured by the amount of land irrigated, groundwater levels, the amount of wildlife habitat for cranes and catfish, and net agricultural benefits did not differ greatly from those of the base case. However, impacts of the diversion scenario were substantial. On the negative side, instream flows and wildlife habitat declined an average of 39%; while, on the positive side, groundwater levels and net agricultural benefits each increased 6%. The modeling process was successful insofar as it promoted an understanding among the highly diverse interest groups of the systems nature of the Basin. One agreement on a water diversion schedule among three of the parties has been reached, partly as a result of this process. More comprehensive compromises have not yet been forged. This experience, however, indicates that modeling success at the policymaking level depends more on the extent to which the policymakers understand the model than it does on model sophistication. (Author's abstract)
W86-00790

TIME AND INSTITUTIONAL REQUIREMENTS,
Interstate Commission on the Potomac River Basin, Rockville, MD.
For primary bibliographic entry see Field 6F.
W86-00796

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

FARMERS' ATTITUDES TOWARD NON-POINT POLLUTION CONTROL AND PARTICIPATION IN COST-SHARE PROGRAMS,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Agricultural Economics.
For primary bibliographic entry see Field 5G.
W86-00782

BARRIER TO UPGRADING FUNDING,
Purdue Univ., Lafayette, IN.
R. O. Walker, Jr.
Water Engineering and Management, Vol. 132, No. 5, p 20-28, May, 1985.

Descriptors: *Infrastructure, *Public policy, *Funding, Policy making, Decision making, Urban planning, Costs, Economic aspects, Cost allocation.

An August, 1984, workshop on 'Technical Alternatives for Urban Infrastructure' brought out several aspects of the infrastructure problem as faced by American cities. The problems of infrastructure are not merely physical, or engineering, problems, but have social, economic, community government, and regulatory aspects. Major social and economic changes, such as the change from an industrial to a service economy, mean that the demands made on the infrastructure are changing. The problem is not merely one of upgrading or repairing existing facilities, but of simultaneously adapting them to changing needs of the users. Funding for major projects is the greatest obstacle to infrastructure improvement now that federal support is being withdrawn. Aside from federal programs, funding methods that have been used include (1) revenue bonds, (2) New Jersey's infrastructure bank, from which local communities may borrow funds at low or no interest, (3) developer exactions, and (4) 'privatization' of the infrastructure. A coalition of all segments forming the framework of the urban infrastructure system and its users should be the source of the information required for the decision-making process. New methods of financing, marketing, and adoption of new technologies must be encouraged and supported. (Rochester-IVI)
W86-00797

OVERCOMING THE BARRIERS,
East Bay Municipal Utility District, Oakland, CA.
J. B. Gilbert.
Water Engineering and Management, Vol. 132, No. 5, p 28-33, May, 1985.

Descriptors: *Infrastructure, *Water conveyance, Management planning, Urban planning, Conveyance structures, Water rates, Economic aspects, Planning.

The problems of infrastructure in the water-supply systems of the United States tend to be concentrated in the older cities of Northeast, where deferred maintenance and unrealistically low water rates have created an accumulation of system problems. Four main areas that each utility manager should address before looking for assistance in resolving problems of inadequate and decaying infrastructure are: (1) an effective preventive maintenance program, (2) a capital program of replacement and improvement as part of the future planning process and annual budget, (3) an equitable water rate structure - sufficient to pay annual costs, including debt service, of a comprehensive rehabilitation program, and (4) a system of charges that places the burden of financing facility expansion on those customers causing the need. The infrastructure barriers are essentially internal to each utility. The ability to use external assistance exists, but for political and other reasons, such assistance may be severely limited in the future. As an enterprise, the water industry is uniquely capable of solving its infrastructure problem because of its particular internal ability to establish water rates that can produce a revenue stream sufficient to pay all operating costs, as well as debt service required to rehabilitate and expand deficient facilities. (Rochester-IVI)
W86-00798

ALTERNATIVE SOLUTIONS,
Johns Hopkins Univ., Baltimore, MD. Dept. of Geography and Environmental Engineering.
J. J. Boland.
Water Engineering and Management, Vol. 132, No. 5, p 33-39, May, 1985. 3 Ref.

Descriptors: *Infrastructure, *Management planning, *Economic aspects, Funding, Privatization, Legal aspects, Planning.

Water/wastewater utilities with infrastructure problems are typically those in need of substantial amounts of capital. The solution to the capital problem consists of two steps: (1) increasing rates sufficiently to halt the erosion of existing capital and to provide for repayment of borrowed funds, and (2) raising needed capital from subsidies, debt proceeds, or current revenues. Within the public sector, subsidy may be disappearing as an option as federal and state government trim their budgets. Long-term debt, through such agencies as 'bond banks' or by conventional, but previously unused, debt sources is one alternative available to the utility manager. For systems with facilities in imminent danger of failure, or to keep capital costs low, short-term debt is appropriate. Sometimes market conditions may actually provide lower rates for short-term instruments. Privatization of all or part of the physical facilities is a method of financing that depends entirely on federal tax law, which provides tax benefits to those acquiring the utility. These indirect subsidies from the federal treasury may permit utilities to acquire needed facilties at a lower cost than would be possible under the public finance alternatives. Institutional changes may also help. For example, a utility could be merged with a stronger utility to provide improved credit and better cash flow. Horizontal mergers are frequently advocated to improve operational efficiency and quality of service, as well as to provide improved access to capital, whereas vertical mergers are often proposed as last-resort solutions to fiscal emergencies. (Rochester-IVI)
W86-00799

FLOTATION THAT MIGHT SINK,
For primary bibliographic entry see Field 6E.
W86-00831

BYZANTINE ART OF WATER UTILITY RATE-MAKING,
Water and Wastewater Equipment Mfrs. Association, Washington, DC.
F. Summer.
Environmental Forum, Vol. 4, No. 1, p 32-38, May, 1985. 10 Ref.

Descriptors: *Economic aspects, *Water treatment, *Utilities, *Costs, Public policy, Management planning, Water distribution.

Factors affecting the setting of water rates are discussed. Water industry costs have two major sources: environmental and health-related requirements and the costs of repair and rehabilitation of facilities. Deferred maintenance is common among utilities, but nearly half of the utilities could eliminate their backlogs through stepped-up construction programs over a 10-yr period. Setting water rates involves a process of matching the costs of providing service to the unique economic, political, and social environments in which a utility provides service. Two methods are generally used for determining total revenue requirements: the case or budget basis and the utility basis. Equitable allocation of costs among customer classes required determination both of the amount of water required by each class and of the peak needs of each customer. Most rate structures used by water utilities include stepped decreases as consumption increases; different classes of customers create different load characteristics. Connection charges help finance new construction and recover some capital costs. Fire protection (hydrant) rates

depend on where a particular hydrant is located (public or private property) and who is responsible for its upkeep. Ultimately, public utility commissions control the rates for most investor-owned systems and for some publicly-owned utilities. The public and its representatives sometimes express the view that water is free, or that water rates should be limited, regardless of the utility's expense in providing it. Costs of water must reflect the benefits derived from it. (Rochester-IVI)
W86-00868

6D. Water Demand

NEW RULES FOR NATIONAL FOREST WATER,
California Univ., Berkeley. Dept. of Forestry and Resources Management.
J. Romm, and K. Bartoloni.
Journal of Forestry, Vol. 83, No. 6, p 362-367, June, 1985. 4 Fig, 3 Ref.

Descriptors: *National forests, *Water rights, *Forests, *Legal aspects, Riparian rights, Organic Act, Federal Land Policy and Management Act, Multiple Use-Sustained Yield Act, Resource allocation, Water allocation.

The decision of the U.S. Supreme Court in the 'Rio Mimbres' case limited the federal reserved right to water, under which the Forest Service had been claiming water for all its various uses of reserved land. Based on an interpretation of the Organic Act of 1897, the court limited the Forest Service's claim to water to that necessary for maintaining timber supplies and favorable water flows. Other uses, such as recreation, fish and wildlife needs, and aesthetics, were not included. Four strategies have been employed by the Forest Service to attempt to regain lost water rights. First, a hydrological argument has been advanced, based on the 1897 Organic Act, that enough water must be allowed to flow through rivers to keep the drainage network in good condition. In California, the Forest Service has asserted its 'riparian rights' as a property owner, to which it is entitled under that states' laws. As a third strategy, the Forest Service is testing the extent of its powers to regulate private uses of national forest water under the Federal Land Policy and Management Act of 1976. Its permit authority under this act may allow it to confine the scope of private water use within national forest boundaries and to expand its control of water allocation. In a fourth strategy, the Forest Service is contending in court that the Multiple Use-Sustained Yield Act of 1960 implied the same reserved rights for 'supplemental' purposes after 1960 as the Organic Act implied for the maintenance of timber supplies and favorable stream flows. Other strategies available include exercising eminent domain power to buy water rights and various cooperative agreements with states and federal agencies for joint management of water and sharing of costs. (Rochester-IVI)
W86-00716

6E. Water Law and Institutions

NEW RULES FOR NATIONAL FOREST WATER,
California Univ., Berkeley. Dept. of Forestry and Resources Management.
For primary bibliographic entry see Field 6D.
W86-00716

SALINITY ISSUES AND WATER DEVELOPMENT IN THE GREEN RIVER BASIN, WYOMING,
Department of Energy, Morgantown, WV. Morgantown Energy Technology Center.
S. D. Cooke, and J. Ahern.
Water Resources Bulletin, Vol. 21, No. 2, p 217-223, April, 1985. 2 Fig, 11 Ref.

Descriptors: *Water resources development, *Salinity, *Green River Basin, *Wyoming, Water allocation, Colorado River Compact, Upper Colorado River Basin Compact, Appropriation, Downstream.

Water development in the Green River Basin of Wyoming is projected to increase salinity downstream in the Green River and Colorado River, and thereby increase salinity costs to users of water from these two rivers. Despite these water quality and economic impacts to downstream water users, Wyoming will probably be able to develop its currently unused but allocated water supplies of the Green River Basin. The Colorado River Compact and Upper Colorado River Basin Compact are binding, and protect Wyoming's share of the Colorado River System waters for future use. The argument that water may be used to greater profit downstream is not sufficient to reduce Wyoming's allocation. In addition, the no-injury rule under the appropriation doctrine of law does not appear to protect prior downstream appropriations from increasing salinity in this case. (Author's abstract)
W86-00783

FLOTATION THAT MIGHT SINK,
F. Pearce.
New Scientist, Vol. 106, No. 1452, p 16-19, April, 1985.

Descriptors: *Privatization, *Public policy, *Water authorities, *Organizations, *England, *Wales, Water treatment facilities, Water districts, Maintenance, Economic aspects, Infrastructure.

None of the 10 regional water authorities in England and Wales that the British government plans to sell to the private sector is without serious infrastructure problems in both the water supply and water treatment phases of its operations. The considerable age of many of the mains, reservoirs and treatment plants, and the fact that maintenance has been significantly curtailed as an economy measure since the mid-1970s, contribute to the major capital needs that these authorities have. Water supplies in many places have severe leaks, bacteriological standards are not met in some cases, Nais worms have been found in the water supply in Sussex, sewer collapses in Yorkshire (64 per 1,000 km of sewer), and problems with inadequate recordkeeping in Wales, are among the numerous problems facing the authorities involved. Many water supplies fail to meet European Economic Community standards. The water authorities (North West, Southern, Yorkshire, Thames, Welsh, South West, Severn Trent, Northumbrian, Wessex, and Anglian) have assets valued at 26 billion pounds sterling, but many of the authorities have hundreds of millions of pounds in deferred maintenance or capital spending that must be done to correct significant problems. In many areas the quality of both drinking water and effluent from treatment plants is declining rather than improving under current management. Investors may be reluctant to take on the responsibility of upgrading the seriously deteriorated facilities that would become theirs if they were to buy them from the government. (Rochester-IVI)
W86-00831

ALTERNATIVE APPROACHES TO ACID RAIN CONTROL,
E. M. Trisko.
Environmental Forum, Vol. 3, No. 12, p 18-23, April, 1985. 1 Fig, 1 Tab, 15 Ref.

Descriptors: *Acid rain, *Water pollution control, *Clean Air Act, *Legislation, Legal aspects, Air pollution, Nitrogen oxides, Sulfur dioxide, Organic compounds, Emission density zoning.

Because Section 126 of the Clean Air Act does not treat acid rain as a pollutant, downwind states have appeared to be at the mercy of upwind polluters. However, acid precipitation can be reduced by enforcing the existing Clean Air Act. At least two mechanisms are now available to EPA: a fine particulate matter standard for sulfates developed under Sections 108 and 109, and enforcement of Section 169A's visibility protection program. If Congress insists on a special legislative remedy for acid rain, existing Clean Air Act programs and principles could supply the foundation for an integrated approach to acid rain control and visibility enhancement. Compared to the emission reduction allocation methods in the principal House and Senate acid rain bills, a new approach based on emission density zoning would be more consistent both with the Act's uniform standards-based approach, and with current scientific understanding of atmospheric transport and deposition. The direction of the Clean Air Act reauthorization debate may change as a result of new evidence, indication that emissions of nitrogen oxide and volatile organic compounds may have a greater effect on forests. Eventually, Congress will have to address the major policy issue underlying the acid rain debate: whether the Clean Air Act adequately protects the environmental values Congress now intends to protect. (Moore-IVI)
W86-00867

6F. Nonstructural Alternatives

TIME AND INSTITUTIONAL REQUIREMENTS,
Interstate Commission on the Potomac River Basin, Rockville, MD.
D. P. Sheer.
Water Engineering and Management, Vol. 132, No. 5, p 14-20, May, 1985. 1 Tab.

Descriptors: *Infrastructure, *Water distribution, *Washington (District of Columbia), Simulation analysis, Computers, Water conveyance.

The value of existing water-supply infrastructure for serving current and future water-supply problems is demonstrated by the case of the Washington (District of Columbia) Metropolitan Area (WMA). Three major water-supply systems had developed to supply WMA as it grew to a population of 3 million people. By 1977, it was felt that a serious risk of supply shortfall during drought existed, and studies were conducted of several improvements to the present system, which cost $200 million to $1 billion and raised numerous objections from affected individual and agencies. A reanalysis of the operations of the individual components of the WMA distribution system, which involved three independently-operated systems, revealed that coordinated operations could make better use of available storage and Potomac River flow, and interconnections among reservoirs were proposed to facilitate this task. Further study showed, however, that no construction was needed at all, and that the existing distribution system could provide the year 2030 requirements without lowering the reservoirs below 40% of capacity. This surprising result was difficult for water managers to understand. Computer-based simulation games allowed managers and operators to grasp the concepts that analysts had had difficulty explaining. As the plan was finalized, the computer simulation model also helped resolve the issue of cost sharing, by letting each utility make its own runs under different hypothetical conditions, to test the proposed operating rules. Hundreds of simulation runs were made, using different droughts and assumptions, before the utilities were satisfied that an equitable allocation of cost had been devised. The WMA case shows how 'existing infrastructure' can be made an asset, rather than a liability needing replacement. (Rochester-IVI)
W86-00796

INNOVATIVE WATER QUALITY-BASED PERMITTING: A POLICY PERSPECTIVE,
Skylonda Group, Inc., Menlo Park, CA.
For primary bibliographic entry see Field 5G.
W86-00839

6G. Ecologic Impact Of Water Development

INVERTEBRATE COLONIZATION RATES IN THE TAILWATER OF A KENTUCKY FLOOD-CONTROL RESERVOIR,
Fish and Wildlife Service, Bowling Green, KY. East Central Reservoir Investigations.
W. D. Swink, and J. F. Novotny.
Journal of Freshwater Ecology, Vol. 3, No. 1, p 27-34, June, 1985. 3 Tab, 17 Ref.

Descriptors: *Invertebrates, *Tailwaters, *Flood-control dams, *Kentucky, Recolonization, Aquatic insects, Oligochaetes, Dam effects, Reservoir releases, Flow discharge, Detritus, Periphyton.

The impoundment and operation of a flood-control reservoir often produce major changes in the flow regime immediately below the dam. Discharges into the tailwater are determined by the method of dam operation and downstream water requirements. In the tailwaters below some flood-control reservoirs, prolonged periods of low discharge may be followed by sustained high flows. Invertebrate colonization on newly introduced rock substrates was examined from July through October 1982 in the tailwater of Barren River Lake, Kentucky. Rock substrates were examined because they are often used as riprap in tailwaters to prevent erosion. Chironomidae, the dominant taxon of benthic insects, reached full colonization by day 14. Colonization by Oligochaeta, the other major invertebrate taxon, was not completed by the end of the 95-day period of observation. Recolonization may have been delayed because insufficient food (periphyton and detritus) had accumulated on the clean rocks. Rapid recolonization of dewatered substrates may be especially critical for maintaining adequate fish food in tailwaters of flood-control reservoirs. (Moore-IVI)
W86-00618

BENTHOS-PLANKTON RELATIONSHIP UPSTREAM AND DOWNSTREAM OF A BLACKWATER IMPOUNDMENT,
Carolina Power and Light Co., New Hill, NC. Harris Energy and Environmental Center.
D. D. Herlong, and M. A. Mallin.
Journal of Freshwater Ecology, Vol. 3, No. 1, p 47-59, June, 1985. 4 Fig, 3 Tab, 24 Ref.

Descriptors: *Benthos, *Plankton, *Reservoirs, *Black Creek, *South Carolina, Upstream, Downstream, Dam effects, Invertebrates, Zooplankton, Phytoplankton, Aquatic insects, Organic matter, Particulate matter.

The phytoplankton, zooplankton, and the macroinvertebrate snag cummunities of Black Creek, South Carolina, upstream and downstream of an impoundment were investigated during 1982. Phytoplankton and zooplankton densities upsteam of the impoundment were very low. The reservoir outflow contributed a large part of the zooplankton of all sizes to the stream immediately below the impoundment. Large copepods and cladocerans were almost absent from the community 2.2 km downstream leaving mainly nauplii, small cladocerans, and rotifers. The reservoir also released a moderate amount of phytoplankton into the stream which was only slightly reduced further downstream. The macroinvertebrate snag community upstream of the impoundment was diverse and was dominated by the filter feeders Simulium and Rheotanytarsus. The community immediately downstream of the impoundment displayed decreased diversity and was dominated by the filter-feeding caddisflies Hydropsyche and Neureclipsis crepuscularis. Further downstream, the community showed increased diversity and a community structure resembling that above the impoundment with Rheotanytarsus dominating the filter feeders. The filter feeders above the impoundment utilized mainly ultrafine particulate organic matter (UPOM) which was probably in the form of bacteria or detritus. Immediately below, the caddisfly community utilized larger fine particulate organic matter and developed as a response to the input of large plankton entering the system. Further downstream, the return of a more diverse community utilizing UPOM paralleled the absence of large zooplankton and the retention of phytoplankton and small zooplankton in the system. (Author's abstract)
W86-00620

MODELING THE CUMULATIVE EFFECTS OF FOREST PRACTICES ON DOWNSTREAM AQUATIC ECOSYSTEMS,
Kock and Associates, Wenatchee, WA.
G. O. Klock.
Journal of Soil and Water Conservation, Vol. 40, No. 2, p 237-241, March/April, 1985. 4 Fig, 4 Tab, 12 Ref.

Descriptors: *Model studies, *Forest management, *Environmental effects, Forest watersheds, Forestry, Watersheds, Management, Water quality, Water quantity, Ecosystems, Computer models.

By modeling key watershed parameters affecting the quantity and quality of water delivered to downstream ecosystems, the KWCEA (a Watershed Cumulative Effects Analysis) model provides an annual index of a watershed's hydrologic condition. The index value implies the cumulative-effects risk that must be assumed with past, current or future watershed forest practices. Of the seven model components, only two require professional judgement - the potential slope stability failure frequency and the time period for a disturbed area within a watershed to become hydrologically mature. Guides are provided to assist in making these judgements. A computer model greatly reduces the time needed to calculate the KWCEA values. The model is particularly useful for evaluating forest practice options within a watershed during planning. Potential levels of downstream impacts can be estimated. The worst-case KWCEA index value or the implied cumulative-effects risk can be calculated and compared with present or future scheduled levels of watershed activity. The output from the KWCEA model provides a much needed data base to coordinate forest activities among several landowners within a watershed. (Baker-IVI)
W86-00651

CHANGES IN SOIL CARBON AND NITROGEN DUE TO IRRIGATION DEVELOPMENT IN NEBRASKA'S SANDHILL SOILS,
Nebraska Univ.-Lincoln. Dept. of Agronomy.
M. A. Lueking, and J. S. Schepers.
Soil Science Society of America Journal, Vol. 49, No. 3, p 626-630, May-June, 1985. 2 Fig, 5 Tab, 22 Ref.

Descriptors: *Irrigation effects, *Soil chemistry, *Carbon, *Nitrogen, *Nebraska, Hydrolyzable nitrogen, Mineralizable nitrogen, Soil depth.

Carbon and N parameters were compared for non-developed and developed soils (predominantly mixed mesic, Typic Ustipsamments, and sandy, mixed mesic Entic Haplustolls). Soil samples were collected from four developed center pivot irrigation sites and from the nondeveloped corners at depth increments of 0- to 75-, 75- to 150-, and 150- to 300-mm. Total C, total Kjeldahl N (TKN), hydrolyzable N, and mineralizable N by autoclave and by 112-d incubation study were determined. Changes in TKN were not significant in the 0- to 75-mm, depth, but in the second depth increment, TKN increased with development (507 to 569 kg/ha). Total C also increased at this depth (5650 to 6400 kh ha-1). The C/N ratio increased with development in the surface 75 mm (11.5 to 12.2). Inorganic N increased in the top 300 mm due to development. Mineralizable N by both techniques increased in the 75- to 150- and 150- to 300-mm depth increments. Steady state values for ln TKN were calculated to be 6.6, 6.4, and 6.8 kg/ha for soil depth increments of 0- to 75, 75- to 150-, and 150- to 300-mm, respectively. The ln total C steady-state values were 9.1, 8.8, and 9.1 kg/ha. In some cases, undeveloped soil contained more N and C than these steady-state values, suggesting that development tended to decrease the soil test values. If the undeveloped soil was lower in N or C than the steady-state value, development tended to increase the test value. Total C, TKN, hydrolyzable N, mineralizable N (both techniques), and inorganic soil N were all highly correlated. Changes in TKN and total C were not correlated to landscape position or time since development. (Author's abstract)
W86-00703

NET BENEFIT MODEL FOR RECREATION PLANNING AT DRINKING WATER RESERVOIRS,
Fitchburg, MA.
For primary bibliographic entry see Field 6G.
W86-00792

NET BENEFIT MODEL FOR RECREATION PLANNING AT DRINKING WATER RESERVOIRS,
Fitchburg, MA.
J. J. Behan, M. Gross, and L. R. Klar, Jr.
Water Resources Bulletin, Vol. 21, No. 2, p 297-309, April, 1985. 3 Fig, 6 Tab, 23 Ref. Department of the Interior project B-078-MASS.

Descriptors: *Recreation, *Environmental effects, *Reservoirs, *Model studies, *Planning, Quabbin Reservoir, Massachusetts, Water quality control, Cost-benefit analysis, Carrying capacity, Multipurpose reservoirs, Nutrients, Drinking water.

A management model was developed for determining levels of recreation activities at public drinking water reservoirs. Quabbin Reservoir, located in central Massachusetts, served as a case study for the model. An interdisciplinary research team was formed to study the impact of selected recreation activities on water quality, public demand and willingness to pay for selected recreation activities, carrying capacity constraints, and the economic cost/benefits associated with increases in recreation at the Quabbin Reservation. Study variables were integrated into a quadratic programming model, producing the number of participants that corresponds to maximum net benefits for specific development packages on design days. The reaction mix associated with maximum net economic benefits was found to be cost-effective (assuming the use of reasonable entrance fees) and not deleterious to water quality. However, as a result of the findings of a related study, it was recommended that nutrients, particularly from wastewater, not be permitted to enter the reservoir, since the current phosphorous level may be at a critical point. Management techniques that would safeguard against the occurrence were recommended. The model was sensitive to management objectives; recommendations were limited to activities that would not lower the existing high quality of Quabbin water. (Author's abstract)
W86-00792

IMPACT OF HYDRAULIC WORKS ON WATER QUALITY, PART TWO,
Electricite de France, Chatou. Direction des Etudes et Recherches.
R. Gras, and J. P. Albignat.
International Water Power and Dam Construction, Vol. 37, No. 5, p 41-46, May, 1985. 11 Fig, 1 Tab, 12 Ref.

Descriptors: *Environmental effects, *Water quality, *Hydraulic structures, Mathematical models, Navigation, Irrigation, Flood control, Ecological effects, Management.

All hydraulic projects, including those to meet quantitative needs (navigation, irrigation, and flood control) have a definite effect on the quality of water, but the magnitude of change to an ecosystem is not always related to the size of the associated hydraulic project. Appropriate design or good management of a project can limit a particular effect on the water quality, although it is necessary to have criteria to follow. Mathematical models allow the problems of conflicting criteria to be analyzed with respect to the estimation of the effects, or to the improvement of the design and selection of proper management. The actual scope for adapting management to meet water quality criteria is limited. (Moore-IVI)
W86-00802

HYDROLOGIC AND VEGETATIONAL CHANGES RESULTING FROM UNDERGROUND PUMPING AT THE CYPRESS CREEK WELL FIELD, PASCO COUNTY, FLORIDA,
Southwest Florida Water Management District, Brooksville.
T. F. Rochow.
Florida Scientist, Vol. 48, No. 2, p 65-80, 1985. 4 Fig, 2 Tab, 17 Ref.

Descriptors: *Wells, *Environmental effects, *Vegetation, *Hydrology, *Cypress Creek Well Field, *Florida, Pumping, Cypress domes, Marshes, Surface water, Aquatic plants, Wetlands.

From 1975-1982 the hydrologic and vegetation response of selected cypress domes and marshes in the Cypress Creek Well Field (Florida) to deep underground pumping was compared to similar sites far removed from water production activities. After water production began, 5 of the 7 wellfield study sites experienced 1 to 5 consecutive years without standing surface water. Control sites had some surface water each year despite differences in yearly precipitation. Wellfield study sites with at least 2 yr without surface water showed a complete loss of typical deep-water aquatic plant species such as pickerelweed (Pontederia cordata) and rush (Juncus repens). At various wellfield impacted sites, maidencane (Panicum hemitomon), willow (Salix caroliniana), blue maidencane (Amphicarpum muhlenbergianum), dog fennel (Eupatorium capillifolium) and buttonweed (Diodia virginiana) became abundant. Vegetation at the control sites was quite stable from 1 yr to the next. (Author's abstract)
W86-00899

7. RESOURCES DATA

7A. Network Design

AUTOMATIC WATER QUALITY MONITORING IN RIVERS EXPOSED TO INJURIOUS ACTIVITIES,
National Board of Waters, Helsinki (Finland).
For primary bibliographic entry see Field 5A.
W86-00671

GENERAL LAKE WATER QUALITY INDEX,
National Board of Waters, Helsinki (Finland).
Water Research Inst.
For primary bibliographic entry see Field 2H.
W86-00673

DENSITY OF PRECIPITATION CHEMISTRY NETWORKS,
Kozponti Cegkorfizikai Intezet, Budapest (Hungary).
L. Haszpra.
Environmental Monitoring and Assessment, Vol. 5, No. 2, p 185-197, June, 1985. 4 Fig, 2 Tab, 13 Ref, 1 Append.

Descriptors: *Precipitation chemistry, *Density, *Network design, Sulfates, Nitrates, Ammonium, Calcium, Water pollution sources, Mathematical models, Statistical models.

Using a mathematical-statistical method the accuracy of the precipitation chemistry networks of different densities were studied. The necessary density of the networks was estimated. The basic principle of network planning methods is the following: the meteorological network covering a given area has to make it possible to determine the value of the meteorological element for any point or any part of the area with the required accuracy. The error of the interpolation for any point or that of the areal averaging for any part of the area must not exceed the maximum value permitted by the investigations. Using Scandinavian precipitation chemistry data the dependence of the accuracy of the interpolation and areal averaging of sulfate, nitrate, ammonium ion and calcium ion contents of precipitation water on the density of the network and on the size of the area considered is studied. The density of networks operation with a given accuracy can be determined as a function of the area. As an example the density of the networks determining the annual and mothly areal SO4(-2) deposition as well as the point values of the monthly SO4(-2) concentration with an accuracy of 1%, 25% and 30%, respectively is calculated. The accuracy provided by such networks for other components in precipitation water is also studied. (Baker-IVI)
W86-00684

ENVIRONMENTAL AUDIT. II. APPLICATION TO STREAM NETWORK DESIGN,
Minnesota Univ., St. Paul. Dept. of Forest Resources.
J. A. Perry, D. J. Schaeffer, H. W. Keršter, and E. E. Herricks.
Environmental Management, Vol. 9, No. 3, p 199-207, May, 1985. 5 Tab, 22 Ref.

Descriptors: *Environmental audit, *Network design, *Streams, Idaho, Sampling, Data acquisition, Data interpretation, Water quality, Decision making, Monitoring, Planning, Management.

The planning and execution of water quality management programs requires careful collection and analysis of data coupled with a systematic review and analysis of programmatic success. The environmental audit is a tool which facilitates improved water quality planning and management. This article demonstrates the utility of the environmental audit by reviewing portions of a comprehensive review of the water quality management program for the state of Idaho. The audit is a tool which forces careful design of a sampling program before data are collected. In the audit approach, program objectives are clearly stated prior to initiation of sampling. Stated objectives are also evaluated regularly to identify tension points, that is, conflicts between expectations and reality. In the example taken from Idaho, a management review team followed a directive to redesign the water quality monitoring program. A summary of the redesign as proposed by that team is presented to illustrate the results of a typical review of monitoring programs. That summary is followed by an example of how the proposed program would differ if the audit approach had been used. The two approaches offered both coincident and conflicting recommendations. Management review team and audit recommendations for lake sampling programs were similar even though a different process was used to develop the recommendatons. The most striking contrast between the two results lies in the review team's approach to the problem. The directives followed, and the team's responses, concentrate on tools, such as increasing biological monitoring or reliance on monthly BWMP stations. In contrast, the audit results stress addressing management questions for which clear objectives have been stated, depending on specific tools only as needed to meet stated objectives. Although the audit does integrate externalities in its structure, it is little affected by economic or political influences. A major strength of the audit approach is its ability to provide defensible data for management decision making. (Author's abstract)
W86-00723

7B. Data Acquisition

DETERMINATION OF MOISTURE IN SOLIDS,
Lawrence Livermore National Lab., CA.
For primary bibliographic entry see Field 2G.
W86-00644

SURFACE SOIL WATER CONTENT MEASUREMENT USING PULSED NUCLEAR MAGNETIC RESONANCE TECHNIQUES,
Agricultural Research Service, Beltsville, MD. Hydrology Lab.
For primary bibliographic entry see Field 2G.
W86-00698

USE OF SEEPAGE METERS TO ESTIMATE GROUNDWATER NUTRIENT LOADING TO LAKES,
Florida Inst. of Tech., Melbourne. Dept. of Environmental Sciences and Engineering.
T. V. Belanger, and D. F. Mikutel.
Water Resources Bulletin, Vol. 21, No. 2, p 265-272, April, 1985. 3 Fig, 6 Tab, 22 Ref.

Descriptors: *Seepage meters, *Nutrients, *Lakes, *Seepage, Groundwater movement, Nitrogen, Phosphorus, Lake sediments, East Lake Tohopekaliga, Florida.

Data from a study on East Lake Tohopekaliga, Florida, indicate that the seepage meter measurement method may often overestimate nutrient contributions to lakes. Nutrient loading data from this method and a method employing lakeside piezometer nutrient data and seepage meter flows were not comparable. Seepage nutrient loading from the meter and piezometer methods comprised 39 and 18% of the nitrogen budget and 38 and 9% of the phosphorus budget, respectively, for East Lake Tohopekaliga. In terms of water, groundwater seepage accounted for only 14% of the total input to the lake. It is felt that some of the past studies using the seepage meter method to estimate nutrient loading may be in error due to reasons related to the enclosure of lake sediments by the meter and the accompanying anaerobic conditions which quickly result. (Author's abstract)
W86-00788

REMOTE DETECTION OF GROUNDWATER CONTAMINANTS USING FAR-ULTRAVIOLET LASER-INDUCED FLUORESCENCE,
Tufts Univ., Medford, MA. Dept. of Civil Engineering.
W. A. Chudyk, M. M. Carrabba, and J. E. Kenny.
Analytical Chemistry, Vol. 57, No. 7, p 1237-1242, June, 1985. 6 Fig, 2 Tab, 16 Ref. NSF grant PRM-8114621.

Descriptors: *Groundwater contamination, *Remote sensing, *Fluorescence, *Pollutant identification, Phenol, Cresol, Toluene, Chlorophenol, Nitrophenols, Xylenes, Detection limits, Humic acids.

Remote fluorescence analysis of groundwater contaminants by using UV lasers and fibers optics was successfully tested. Several priority pollutants (phenol, o-cresol, toluene, o-chlorophenol, p-nitrophenol, 2,4-dinitrophenol, and xylenes) as well as naturally occurring humic acid, at environmentally significant concentrations, were readily detected by using the technique. At an instrument/analyte distance of 25 m, which equals or exceeds the depth of many aquifers used as drinking-water supplies, individual compounds had detection limits at or below the parts per billion level. Phenolic and humic acid contaminants in actual landfill and barkpile leachates were easily detected at 25 m after 10,000-fold dilution. Practical problems in implementing a UV-laser-based system, such as efficient coupling, fiber damage threshold (approximately 15 MW/sq cm), scattered light, shape of response curve, etc., have been examined and simple solutions demonstrated. (Author's abstract)
W86-00818

MICROARRAY ELECTROCHEMICAL FLOW DETECTORS AT HIGH APPLIED POTENTIALS AND LIQUID CHROMATOGRAPHY WITH ELECTROCHEMICAL DETECTION OF CARBAMATE PESTICIDES IN RIVER WATER,
Georgia Univ., Athens. Dept. of Chemistry.
J. L. Anderson, K. K. Whiten, J. D. Brewster, T.-Y. Ou, and W. K. Nonidez.
Analytical Chemistry, Vol. 57, No. 7, p 1366-1373, June, 1985. 6 Fig, 3 Tab, 47 Ref.

Descriptors: *Electrochemical flow detectors, *Liquid chromatography, *Carbamates, *Insecticides, Chromatography, Microarray electrodes, Solid electrodes, Kelgraf, Pesticides, Chemical analysis.

The properties and advantages of microarray electrodes are discussed relative to solid electrodes as flow detectors. Amperometric response for a series of Kelgraf microarray electrodes of varying percent graphite is in agreement with theoretical predictions. The Kelgraf electrode effectively discriminates between oxidation reactions limited by the rate of mass transport and reactions (including solvent oxidation) limited by the rate of electron transfer or other surface processes, affording improved detection limits at high applied potentials. The advantages are illustrated for measurement of carbamate pesticides spiked into a river water matrix, using liquid chromatography with electrochemical detection. Subnanogram detection limits

(in the 50-430-pg range) are obtained in all cases with minimal sample cleanup or pretreatment, with as much as 60-fold improvement over other reports for glassy carbon or alternative LC detectors in the best cases. The relative magnitudes of pesticide current response at Kelgraf and glassy carbon electrodes under identical conditions are consistent with theoretical predictions, while enhancements in the signal/noise ratio are slightly lower than expected. (Author's abstract)
W86-00820

7C. Evaluation, Processing and Publication

GEOGRAPHIC INFORMATION SYSTEMS FOR NATURAL RESOURCE MANAGEMENT,
Oklahoma State Univ., Stillwater. Center for Applications of Remote Sensing.
S. J. Walsh.
Journal of Soil and Water Conservation, Vol. 40, No. 2, p 202-205, March/April, 1985. 4 Fig, 10 Ref.

Descriptors: *Water management, *Maps, *Resources development, Remote sensing, Planning, Runoff, Model studies, Data processing.

The ability to turn analog information into digital data and then to edit, store, and display the data as maps or color images has a variety of applications in resource management and regional planning. Land use planners, engineers, agriculturalists, and many others use maps or images displaying soil type, geology, land use, hydrology, and other natural resource data on a daily basis. The advantages of archiving these data in a geographic information system include ease of retrieval, variety of output products to fit almost any need, and the ability to discover and display information gained by testing the interactions between natural resources phenomena and to organize and appraise variable coefficients for predictive models. A need exists to estimate runoff as a function of soil, vegetation, and antecedent moisture and to simulate physically based elements on the natural system on a temporal and spatial basis. Organizing data in a geographic information system permits the appraisal of nonpoint pollution over extensive areas and on a repetitive schedule. Such a system also provides a framework for identifying and managing areas that contribute in relative amounts to the runoff problem. (Baker-IVI)
W86-00649

8. ENGINEERING WORKS

8A. Structures

STATE OF THE ART ON THE DIMENSIONING OF SPILLWAYS FOR DAMS, APPENDIX: CROSSED JET SPILLWAYS (ETAT DES CONNAISSANCES SUR LE DIMENSIONNEMENT DES EVACUATEURS DE CRUE DES BARRAGES, ANNEXE: EVACUATEURS A JETS CROISES),
Hidroprojecto, Lisbon (Portugal).
A. Lencastre.
Houille Blanche, No. 1, p 19-52, 1985. 19 Fig, 3 Tab, 79 Ref.

Descriptors: *Spillways, *Design criteria, *Crossed-jet spillways, Turbulent flow, Energy dissipation, Scour, Hydraulic design, Intakes.

A summary is given of the state-of-the-art on the dimensioning of spillways, having in mind their evolution and analyzing : the intake components; the zone upstream of the intake as far as the energy dissipation; the dynamics of the jets; turbulent pressures in lined stilling basins; the scour process. Lastly, a theoretical and experimental study is made on the effect of the shock between the descending jets of the surface spillways and the ascending jets of the bottom jets - crossed jets - results being presented that make it possible to estimate the reduction in the scour potential of the whole discharge. (Author's abstract)
W86-00655

WHAT'S GOING ON UNDER CHICAGO,
De Leuw, Cather and Co., Chicago, IL.
E. McGuire.
Pollution Engineering, Vol. 17, No. 2, p 29-32, February 1985. 2 Fig.

Descriptors: *Chicago, *Calumet Pumping Station, *Illinois, *Tunnels, *Pumping stations, Pumps, Sewers, Main sewers, Wastewater facilities, Water transport.

The Calumet Pumping Station, a part of the Chicago (Illinois) Tunnel and Reservoir Plan (TARP), uses six computer-controlled centrifugal pumps with a combined capacity of 280,000 gallons per minute (gpm) to deliver wastewater at a suction head varying from +5 to -322 ft Chicago City Datum. Unlike a conventional lift station, the Calumet Pumping Station, which will go on line in early 1985, will discharge directly into the sewage treatment works, and has been designed to function on flow demand rather then maintenance of a wet shaft water level. The system includes two pump rooms, located 350 ft below grade, interconnecting shafts and an electric substation, and various above-ground support facilities. The pumps selected include two types: four with infinitely variable-speed transmissions coupled to 6,000 horsepower (hp) synchronous motors, with rotation speeds from 0-600 revolutions per minute, and two constant-speed units driven by 2,500 hp induction motors. The control system allows operation automatically from a remote control room, manually from the same control room, or locally from control panels located adjacent to the equipment being controlled. Six ultrasonic flow meters provide continuous flow measurements to computers, which govern the system and record 44 separate functions, each of which can be assigned to trend recorders for analysis as part of the preventive maintenance program. Quick-closing valves (84 inches in diameter) are provided for security against flooding of the pump room, and fire, hazardous gas, and oxygen deficiency are monitored, with automatic responses to an emergency programmed into the controls of support systems. Trash removal is by bar screens, screen rakes, and skip hoists, with disposal off site. A 16-foot diameter equipment shaft is provided for each pump room, with a 40-ton capacity overhead crane for moving equipment. (Rochester-IVI)
W86-00767

LARGE-DIAMETER FLEXIBLE STEEL PIPES FOR THE TRANSFER WORKS OF THE KIELDER WATER SCHEME,
Babtie, Shaw and Morton, Glasgow (Scotland).
For primary bibliographic entry see Field 8G.
W86-00832

SUPERHYDRO,
A. Danilevsky.
Civil Engineering, Vol. 54, No. 11, p 54-57, November, 1984. 1 Fig.

Descriptors: *Hydroelectric plants, *Pumped storage, *Dams, *Bath County, *Virginia, Reservoirs, Tunnels, Electric power production.

When the Bath County (Virginia) Pumped Storage Project is completed in 1986, it will be the world's largest, with six turbine/pump generator/motor units rated at 2,100 Mw. Bath County is in the James River basin, high in the ridges and valley of the Appalachian Mountains. Conduits in rock connect the upper lake to the lower one with a drop of about 1,200 ft from the upper lake to powerhouse over a more than 8,000 ft route. Two dams are involved, both of earthfill/rockfill type with impervious cores. The upper dam is 460 ft high and 2,200 ft long; the lower dam is 150 ft high and had a spillway designed to carry 38,000 cu ft/sec. The reinforced concrete powerhouse is designed to resist being submerged to 6 ft above its roofline, with only the parapet protecting it from flooding. The main generator hall contains six bays, each with a reversible turbine/pump connected to a reversible generator/motor unit. Each unit has a rated 3,350 Mw generating capacity at a rated 1,262 ft head and required 410 Mw when reversed. A 500 kv switchyard is on the roof deck, and nine 300 Mva transformers are upstream in the powerhouse yard. Three 28.5 ft diameter tunnels lined with 18 in concrete will be used to connect the upper and lower reservoirs. A 986-ft vertical shaft about midway along the tunnel accounts for most of the vertical drop to save excavation costs. Surge chambers, located just upstream from the vertical shafts, are 330 ft high and 44 ft in diameter. (Rochester-IVI)
W86-00883

ITAIPU, SOUTH AMERICA'S GRANDE DAME,
Itaipu Binacional, Rio de Janeiro (Brazil).
J. R. Cotrim, H. W. Krauch, and G. S. Sarkaria.
Civil Engineering, Vol. 54, No. 12, p 40-43, December, 1984. 2 Fig.

Descriptors: *Itaipu, *Brazil, *Paraguay, *Parana River, *Hydroelectric plants, *Hollow dams, Costs, Dam construction, Construction costs, Dams.

The world's highest and largest hollow gravity dam was built at Itaipu, on the Parana River between Brazil and Paraguay. The structure is 643 ft high and 25,400 ft long. Key elements in the success of the project were timely diversion of the river through a single diversion channel, which prevented an 8-mo delay in construction that would have cost $300 million in interest charges, construction of suitable cofferdams of 295 ft and 246 ft high, and maintenance of minimum flow as the reservoir filled. The selection of the hollow gravity design saved 2.1 million cubic yards of concrete compared to a solid gravity design. An unexpected combination of flooding conditions necessitated changes in the planned filling procedure; all 14 spillway gates, each 65.6 x 70 ft, were opened 15 days after storage began. The Itaipu spillway will be required to operate continuously until more power units can be installed. The maximum spillway discharge so far has been 1,348,000 cu ft/sec, 61% of the design capacity. Two 700 Mw generating units became operational in 1984; all 18 units will be operational in 1990 when the project capacity will be 12,000 Mw. The Itaipu project, when completed, is estimated to cost $15 billion (1983 dollars), of which about 36% is for interest and financial charges. The system will operate as a base-load power plant with very little drawdown, which will ensure high operational efficiency and low maintenance costs. (Rochester-IVI)
W86-00886

PROPORTIONAL WEIRS FOR STORMWATER POND OUTLETS,
EGC-Southwell, Inc., Englewood, CO.
A. Sandvik.
Civil Engineering, Vol. 55, No. 3, p 54-56, March, 1985. 4 Fig.

Descriptors: *Weirs, *Proportional weirs, *Storm runoff, *Detention reservoirs, Construction, Costs, Flood protection, Dams.

A proportional weir to control outflow from a stormwater pond near Denver, Colorado, provides a way to restrict floodwater release from a developed site to historic flows, thus preventing downstream property damage and resulting legal claims. The proportional weir uses an outlet that decreases in width towards its top, with cross-sectional dimensions adjusted so that there is a linear relationship between head and discharge. The weir was sized based on the maximum head available in the pond and the maximum discharge that the weir was allowed to pass (100-yr historic). The approximate maximum storage volume for the stormwater pond was found by determining the areas between the historic and post-development storm hydrographs. The proportional weir outlet structure was constructed of reinforced concrete, with each side supported by a counterfort extending perpendicular to the weir in the upstream direction. The weir edge was constructed by bending two steel channel sections to the dimensions outlining the weir.

An energy dissipator consisting of 18-24-in riprap was placed immediately downstream, depressed 4 ft. In 1982, the weir cost $43,000, with an additional $118,000 required for a flashboard dam. Cost of grading the detention pond was additional. (Rochester-IVI)
W86-00887

HYDRAULIC FILL DAM MADE EARTHQUAKE RESISTANT,
East Bay Municipal Utility District, Oakland, CA.
H. J. Billings.
Civil Engineering, Vol. 55, No. 6, p 56-59, June, 1985. 4 Fig.

Descriptors: *Hydraulic-fill dams, *Earthquake engineering, *San Pablo, *California, Dams, Geologic faults, Construction criteria, Buttress dams.

An earthfill buttress, combined with a sand (drain) blanket, was used to protect the dam at the San Pablo (California) reservoir from the potential effects of earthquakes. The dam, built in 1919-21 by hydraulic fill methods, lies relatively close to the active Hayward, Calaveras, and San Andreas faults. Of 20 originally studied construction alternatives, seven were considered feasible: an upstream rockfill buttress, a new dam at one of three locations, an upstream earthfill buttress, a replacement of the existing dam, and a partial replacement of the existing dam. The upstream fill buttress was not only the most economical, but was most desirable from engineering and environmental viewpoints. To install the 50-60 ft-thick buttress, the reservoir had to be dewatered. Water supply was ensured by constructing a temporary pumping plant and a temporary pipeline running along the reservoir shoreline and into the raw water line below the reservoir. The discovery that porewater pressures equal to 100% of the amount required for liquefaction could occur during an earthquake both within the dam and within the impervious buttress necessitated installation of drains. A 3 ft-thick sand blanket was installed, complete with three new vertical vents, between the dam and the new buttress, to ensure that pore pressures would be released into the reservoir. Vertical sand drains were also drilled within the original dam cross-section. The project cost $16.4 million, of which $3.3 million was for the bypass waterway system. (Rochester-IVI)
W86-00888

8B. Hydraulics

MODELLING VIBRATION AND VORTEX FORMATION AT PIEDRA DEL AGUILA,
Ecole Polytechnique Federale de Lausanne (Switzerland). Lab. d'Hydraulique.
J. Bruschin.
International Water Power and Dam Construction, Vol. 37, No. 5, p 21-24, May, 1985. 9 Fig, 4 Ref.

Descriptors: *Vibrations, *Vortices, *Piedra del Aguila, *Dams, Service gates, Cavitation, Spills.

Model tests were used to successfully define and correct vibration and vortex formation problems associated with the Piedra del Aguila dam. The Piedra spillway uses 15 x 18.5 m radial gates and 3 x 2 m maintenance and service gates at the bottom outlet. Runs with the spillway on the general 1:130 model demonstrated active, partly air-entraining, vortices in the inlet bays upstream from the spillway crest. Observations were conducted and vortices were ranked in terms of strength, size, and persistency, scale effects were estimated, and vortex-suppressing measures were proposed and tested. Modification of bay or pier shape was eliminated as a potential solution after testing, but vortex-suppressing collars around the pier heads efficiently suppressed the vortices. A boundary layer suction device also was designed and tested. Testing at scale 1:25 showed that the device worked smoothly if well submerged, even under rather high heads. Systematic tests were conducted with the service gate opened at 31.49% and 77% of the total aperture while the maintenance gate was progressively lowered, because this operational procedure seemed most likely to uncover vibration and cavitation risks according to the results of earlier tests. Large sub-atmospheric pressures with important fluctuations (standard deviation = 1/3 of the average pressure value) were found between the two gates. It was observed, however, that a very small displacement of the maintance gate produced an abrupt change in the pressure pattern, so this condition was discarded from the list of high-risk situations being considered. (Rochester-IVI)
W86-00800

SIMPLE GOVERNING AND SURGING SIMULATION, PART ONE,
Queen's Univ., Kingston (Ontario). Dept. of Mechanical Engineering.
R. A. Chaplin.
International Water Power and Dam Construction, p 25-28, May, 1985. 2 Fig.

Descriptors: *Surges, *Governing stability, *Turbines, *Simulation, Mathematical equations, Hydroelectric plants, Hydraulic transients, Computers.

This article considers the governing stability of hydro turbines and the hydraulic transients in waterways following various changes in operating conditions. The appropriate mathematical equations are derived to give the necessary background for an overall understanding of the formulation of the expressions and physical phenomena. The equations are then put together to create a simple but effective method of determining the overall transients occurring in hydro powerplant following a disturbance. The resultant computer program (to be published in Part Two) can be used on any desk top computer to study various elementary transients. The emphasis is on simplicity since the program lends itself by expansion, to reasonable degree of elaboration. (Author's abstract)
W86-00801

8C. Hydraulic Machinery

HYDRO-PLANT UPGRADES YIELD RELIABLE, COST-EFFECTIVE KILOWATTS,
J. Makansi.
Power, Vol. 129, No. 5, p 61-63, May. 1985. 6 Ref.

Descriptors: *Hydroelectric plants, *Costs, *Upgrading, Capacity, Power plants, Turbines, Generators, Maintenance.

Older hydroelectric plants often have additional capacity available if steps are taken to upgrade equipment to the best modern standards. Efficiency of turbine runners may be improved by replacing carbon steel runners with those made of stainless steel (integrally cast). Uprating of a turbine/generator usually means more water flow through the unit, which generates a requirement for upgrading of other elements, such as wicket gates, seals, and operating procedures intended to balance runner cavitation, output, and minimum tailwater elevation. The Electric Power Research Institute and others recommend that generator stator windings be subjected to a comprehensive program of dielectric measurements, supplemented by visual inspections at regular intervals, so that trends in performance and condition can be used to predict when rewinding is necessary. Uprating a turbine/generator may necessitate improving of coupling bolts, rotor hubs, spider assemblies, and shafts because these components may be subjected to greater stresses and thermal loads. The thrust bearing load should also be examined when upgrading a system. Modern instrumentation provides many more measurements than are normally offered with older systems. (Rochester-IVI)
W86-00804

EVALUATING PUMP CHARACTERISTICS IN DEVELOPING COUNTRIES,
North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
J. Briscoe.
Civil Engineering, Vol. 54, No. 11, p 58-61, November, 1984. 1 Tab, 7 Ref.

Descriptors: *Pumps, *Developing countries, *Evaluation, Pump testing, Performance evaluation, Training, Algorithm.

Using theoretical considerations, forms were developed to relate pump parameters (eg, revolutions per minute, impeller diameter, and discharge pipe diameter) to pump performance characteristics (flow and head), and the results were presented in a table. Pump types included in the table are manual reciprocating, motor-driven reciprocating, simple centrifugal, multistage pumps (including turbine pumps for boreholes), helical rotary borehole pumps, and hydraulic rams. Formula for calculating electric and diesel motor sizes are provided also. For each type of pump in the table, an example calculation is worked using the table information, with each step in the calculation included. The table should be useful to those water personnel in developing countries who have experience with the approximations and limitations involved in this type of performance estimation. For water technician training, the approach used here can be adapted to the types of pumps used in particular regions. (Rochester-IVI)
W86-00884

8E. Rock Mechanics and Geology

SEISMIC MICROACTIVITY AND WATER LEVEL VARIATION IN INDUSTRIAL AREA NEAR FLORENCE (ITALY),
Florence Univ. (Italy). Ist. di Geologia e Paleontologia.
For primary bibliographic entry see Field 2F.
W86-00632

HYDROGEOLOGICAL PROSPECTING GROUP AND TYPES OF MINERAL DEPOSITS FILLED WITH KARST WATER IN CHINA (IN CHINESE).
For primary bibliographic entry see Field 2F.
W86-00897

8G. Materials

LARGE-DIAMETER FLEXIBLE STEEL PIPES FOR THE TRANSFER WORKS OF THE KIELDER WATER SCHEME,
Babtie, Shaw and Morton, Glasgow (Scotland).
N. S. M. Berry, F. M. Forsyth, and J. Temporal.
Journal of the Institution of Water Engineers and Scientist, Vol. 39, No. 2, p 113-133, April, 1985. 14 Fig, 2 Tab, 12 Ref.

Descriptors: *Pipelines, *Kielder Water Scheme, *England, Pipes, Conveyance structures, Construction methods, Construction materials, Steel, Stress, Materials testing.

A large-diameter pipe was selected and installed for the pumping main (2,020 mm outside diameter) and aqueducts crossing the Wear and Derwent Valleys (2,890 mm inside diameter) and is intended to transfer water as part of a flow augmentation scheme for the River Tees (northeastern England). Design requirements included the ability to operate at either 'normal' pumping level (546 million liters/day) or 'abnormal' pumping level (942 million liters/day). In addition to hydraulic pressures, pipes were chosen to withstand handling and the effects of both transverse and radial external loads, which could act on the buried pipes. Pipe deflection and stress measurements were obtained for finished sections. Installation had to take into account the problem of possible floating of the empty pipe as it crossed floodplains at below river level. Spirally-welded steel pipe was the only practical choice of material; 43A and 50B steels were used, and a special joint, the Babtie/Byard joint, was designed for this pipeline. Ultimately, the pipe was given a cement mortar lining, which was almost entirely placed by machine because of careful attention to pipe joint details. Trench bottoms were precompacted, and graded crushed limestone fill was used to achieve suitable support for the pipe

because none of the local materials was suitable for refilling the excavation. Movement of machinery across the pipe was controlled, although there were breaches of the rules, which did cause pipe deflections. There was reasonable agreement between field measurements and theoretical predictions of flexible pipe design method. The maximum recorded stress was some 40% of the yield stress of mild steel. Deviation of the pipe was limited to + or - 2% to enable cement mortar lining. Consequently, the buckling limit of the pipe is not likely to be reached; the minimum factor of safety against buckling is 3. Some pipes were pre-deflected prior to installation. This approach was useful in limiting the final eccentricity of the buried flexible pipes, but installing of props caused some problems. (Rochester-IVI)
W86-00832

8I. Fisheries Engineering

DISTRIBUTION PATTERN OF DENITRIFYING BACTERIA IN FISH PONDS OF DIFFERING FARMING MANAGEMENTS,
Kalyani Univ. (India). Dept. of Zoology.
For primary bibliographic entry see Field 2H.
W86-00622

FRESHWATER AQUACULTURE IN CHINA: ECOSYSTEM MANAGEMENT FOR SURVIVAL,
New Alchemy Inst., East Falmouth, MA.
For primary bibliographic entry see Field 2H.
W86-00664

NATURAL OCCURRENCE OF PIKE-PERCH (STIZOSTEDION LUCIOPERCA (L.)) AND SUCCESS OF INTRODUCTIONS IN RELATION TO WATER QUALITY AND LAKE AREA IN FINLAND,
Finnish Game and Fisheries Research Inst., Helsinki. Fisheries Div.
For primary bibliographic entry see Field 2H.
W86-00678

POLLUTION LOADINGS FROM FINNISH INLAND FISH-FARMS: A CASE STUDY,
Kuopio Univ. (Finland). Dept. of Occupational and Industrial Hygiene.
For primary bibliographic entry see Field 5B.
W86-00680

SEPARATING STARVATION LOSSES FROM OTHER EARLY FEEDING FRY MORTALITY IN STEELHEAD TROUT SALMO GAIRDNERI, CHINOOK SALMON ONCORHYNCHUS TSHAWYTSCHA, AND LAKE TROUT SALVELINUS NAMAYCUSH,
New York State Dept. of Environmental Conservation, Albany. Bureau of Environmental Protection.
For primary bibliographic entry see Field 5C.
W86-00728

SUBJECT INDEX

A-B PROCESS
A-B Process: A Novel Two Stage Wastewater Treatment System,
W86-00750 5D

ACID EXTRACTION
Effect of Aeration, Cadmium Concentration, and Solids Content on Acid Extraction of Cadmium from a Municipal Wastewater Sludge,
W86-00846 5D

ACID LAKES
Zinc Deposition in Acid Lakes: The Role of Diffusion,
W86-00689 5B

ACID MINE DRAINAGE
Watershed Planning for Acid Mine Drainage Abatement,
W86-00787 4D

ACID PHOSPHATASE
In Vitro Effect of Mercuric Chloride on Acid and Alkaline Phosphatase Activity of a Freshwater Prawn,
W86-00625 5C

ACID RAIN
Model of Sulphate Concentration in a Small Stream in the Harp Lake Catchment, Ontario,
W86-00629 5B

Bacteriological Survey of Two Acid-Stressed Lakes in the Poconos before Limestone Application,
W86-00634 5C

Analysis of Precipitation Chemistry Data from Alaska,
W86-00659 2K

Acidification of Southern Appalachian Lakes,
W86-00663 5B

Long-Term Ecosystem Stress: The Effects of Years of Experimental Acidification on a Small Lake,
W86-00688 5C

Chemical Components in the Precipitation at Komoro and Tsukuba, Japan in 1983,
W86-00810 5B

Effect of Acid Rain on Soils,
W86-00858 5C

Alternative Approaches to Acid Rain Control,
W86-00867 6E

ACIDIFICATION
Acidification of Southern Appalachian Lakes,
W86-00663 5B

Long-Term Ecosystem Stress: The Effects of Years of Experimental Acidification on a Small Lake,
W86-00688 5C

ACIDITY
Effect of Acid Rain on Soils,
W86-00858 5C

ACTIVATED BIOFILTERS
Activated Biofilter Process for Wastewater Treatment,
W86-00871 5D

ACTIVATED SLUDGE PROCESS
Role of an Anaerobic Stage on Biological Phosphorus Removal,
W86-00738 5D

Location of Phosphorus in Activated Sludge and Function of Intracellular Polyphosphates in Biological Phosphorus Removal Process,
W86-00740 5D

Oxidation of Sulfide and Thiosulfate and Storage of Sulfur Granules in Thiothrix from Activated Sludge,
W86-00745 5D

Mixing and Detention Time Distribution in Activated Sludge Tanks,
W86-00747 5D

Equalization Control Strategy for Activated Sludge Process Control,
W86-00749 5D

Flexible Modelling of the Activated Sludge System - Theoretical and Practical Aspects,
W86-00751 5D

Determination of Kinetic Constants of Activated Sludge Microorganisms,
W86-00752 5D

Development of Pollutant Specific Models for Toxic Organic Compounds in the Activated Sludge Process,
W86-00754 5D

Activated Biofilter Process for Wastewater Treatment,
W86-00871 5D

ADENOSINE TRIPHOSPHATASE
Effects of Some Divalent Metals on Cardiac and Branchial Ca2+-ATPase in Freshwater Fish Saccobranchus fossilis,
W86-00880 5C

ADIRONDACK MOUNTAINS
Relationships Between Surface Sediment Diatom Assemblages and Lakewater Characteristics in Adirondack Lakes,
W86-00829 2H

ADSORPTION
Chemical Characterization of Estuarine Colloidal Organic Matter: Implications for Adsorptive Processes,
W86-00640 2L

Binding of Cadmium, Copper, and Lead Ions by Modified Cellulosic Materials,
W86-00692 5D

Lumped-Parameter Modeling of Multicomponent Adsorption in the Treatment of Coal-Conversion Wastewater by GAC,
W86-00815 5D

Bacterial Adsorption and Suspended Particles in Urban Stormwater,
W86-00842 5B

Modification of a Metal Adsorption Model to Describe the Effect of pH,
W86-00847 5B

Sorption of Mercury(II) by Humic Acids,
W86-00866 5B

ADSORPTIVE BUBBLE FLOTATION
Removal of Arsenic from Geothermal Fluids by Adsorptive Bubble Flotation with Colloidal Ferric Hydroxide,
W86-00662 5D

AERATION
Effect of Aeration, Cadmium Concentration, and Solids Content on Acid Extraction of Cadmium from a Municipal Wastewater Sludge,
W86-00846 5D

AEROBIC DIGESTION
Influence of Macromixing on Organic Carbon Uptake and Solids Production by Aerobic Suspended Biomass,
W86-00748 5D

AEROBIC SUSPENDED BIOMASS
Influence of Macromixing on Organic Carbon Uptake and Solids Production by Aerobic Suspended Biomass,
W86-00748 5D

AGRICULTURE
Control of Metal Application Rates from Sewage Sludge Utilization in Agriculture,
W86-00854 5G

AIR POLLUTION
Eulerian Model for Scavenging of Pollutants by Raindrops,
W86-00718 5B

AIR STRIPPING
Removing VOC from Groundwater; Pilot, Scale-up, and Operating Experience,
W86-00816 5F

Packed Tower Aeration Strips Trichloroethylene from Groundwater,
W86-00817 5F

AIR TEMPERATURE
Influences of Snow Cover and Soil Moisture on Monthly Air Temperature,
W86-00860 2A

ALASKA
Analysis of Precipitation Chemistry Data from Alaska,
W86-00659 2K

Gold-Mining Effects on Stream Hydrology and Water Quality, Circle Quadrangle, Alaska,
W86-00785 4C

Gold-Mining Effects on Heavy Metals in Streams, Circle Quadrangle, Alaska,
W86-00786 5C

ALDRIN
Metabolism of Aldrin by the Freshwater Planarian Phagocata gracilis,
W86-00693 5C

Persistence of Aldrin in Flooded Soil under the Cover of Rice,
W86-00875 5B

ALGAE
Influence of Oil Refinery Effluents on the Structure of Algal Communities,
W86-00623 5C

Toxicity and Accumulation of Copper and Cadmium in the Alga Scenedesmus obliquus LH,
W86-00697 5C

ALGAL GROWTH
Water Quality Model for Lake Kuortaneenjarvi, a Polyhumic Finnish Lake,
W86-00677 2H

ALKALINE PHOSPHATASE
In Vitro Effect of Mercuric Chloride on Acid and Alkaline Phosphatase Activity of a Freshwater Prawn,
W86-00625 5C

ALLIUM TEST
Allium Test on River Water from Braan and Saxan Before and After Closure of a Chemical Factory,
W86-00667 5A

ALLUVIAL FANS
Alluvial Fans: Novel Flood Challenge,
W86-00885 2E

ALUM
Distribution of Aluminum in the Tissues of Three Fish Species,
W86-00621 5C

ALUMINUM
Distribution of Aluminum in the Tissues of Three Fish Species,
W86-00621 5C

Influence of pH on the Binding Capacity and Conditional Stability Constants of Aluminum and Naturally-Occurring Organic Matter,
W86-00773 2K

Removal of Naturally Occurring Compounds by Coagulation and Sedimentation,
W86-00855 5F

AMINOCARB
Distribution and Persistence of Aminocarb in Stream Water, Sediment and Fish After Application of Three Matacil Formulations,
W86-00811 5B

Sorptive Capacity of an Aquatic Macrophyte for the Pesticide Aminocarb,
W86-00812 5A

ANAEROBIC CONTACT DIGESTION
Thermophilic Anaerobic Contact Digestion of Palm Oil Mill Effluent,
W86-00744 5D

ANAEROBIC DIGESTION
Role of an Anaerobic Stage on Biological Phosphorus Removal,
W86-00738 5D

Batch Anaerobic Methanogensis of Phenolic Coal Conversion Wastewater,
W86-00743 5D

Structured Modeling of the Anaerobic Digestion of Biomass Particulates,
W86-00848 5D

Performance of an Upflow Anaerobic Reactor Combining a Sludge Blanket and a Filter Treating Sugar Waste,
W86-00889 5D

Anaerobic Pretreatment Reduces Mill Costs, Improves Effluent Quality,
W86-00890 5D

Anaerobic Wastewater Treatment System Operates at Very Low Cost,
W86-00893 5D

ANAEROBIC RETENTION TIME
Influence of Extended Anaerobic Retention Time on the Performance of Phoredox Nutrient Removal Plants,
W86-00739 5D

ANIMAL BEHAVIOR
Effects of Cadmium and Copper on Chemotaxis of Marine and Freshwater Ciliates,
W86-00696 5C

ANIMAL GROWTH
Growth Inhibition and Recovery in Mussels (Mytilus edulis) Exposed to Low Copper Concentrations,
W86-00668 5C

Effect of Velocity of Water Flow on Growth of Colonial Hydroids (Hydrozoa, Thecaphora),
W86-00722 2H

ANIMAL PHYSIOLOGY
Metabolism of Aldrin by the Freshwater Planarian Phagocata gracilis,
W86-00693 5C

ANIMAL TISSUES
Organochlorine Residues in Animals from Three Louisiana Watersheds in 1978 and 1979,
W86-00691 5B

ANION-EXCHANGE RESINS
Separation and Determination of Selenium(IV) in Environmental Water Samples by an Anion-Exchange Resin Modified with Bismuthiol-II and Diaminonaphthalene Fluorophotometry,
W86-00825 5A

ANTARCTIC
Trace-Metal Concentrations in Sediments from Two Closed-Basin Lakes. Antarctica,
W86-00770 2H

APPALACHIANS
Acidification of Southern Appalachian Lakes,
W86-00663 5B

AQUACULTURE
Freshwater Aquaculture in China: Ecosystem Management for Survival,
W86-00664 2H

AQUATIC ANIMALS
Abiotic and Hydrobiologic Characteristics of the Mediterranean Running Waters (Caracteristiques Abiotiques and Hydrobiologiques des Eaux Courantes Mediterraneennes),
W86-00919 2H

AQUATIC ENVIRONMENT
Rate of Bacterial Mortality in Aquatic Environments,
W86-00777 2A

AQUATIC INSECTS
Influence of Development of the River Widawka on the Ephemeroptera Fauna (Influence des Amenagements de la Riviere Widawka sur la Faune des Ephemeropteres),
W86-00914 5C

AQUATIC PLANTS
Historical Changes in Submerged Macrophyte Communities of Upper Chesapeake Bay,
W86-00828 2H

Aquatic Angiosperm Communities from Lochs on Rhum,
W86-00906 2H

AQUIFERS
Step-Drawdown and Constant-Rate Pumping Tests,
W86-00712 2F

Fossil Water under the Sinai-Negev Peninsula,
W86-00911 2F

AROMATIC COMPOUNDS
Potential Use of Enzymes for Removal of Aromatic Compounds from Water,
W86-00753 5F

ARSENIC
Mobility of Zinc, Cadmium, Copper, Lead, Iron and Arsenic in Ground Water as a Function of Redox Potential and pH,
W86-00706 5B

ARSENIC COMPOUNDS
Removal of Arsenic from Geothermal Fluids by Adsorptive Bubble Flotation with Colloidal Ferric Hydroxide,
W86-00662 5D

ASBESTOS
Asbestos in Drinking Water
W86-00853 5B

ATTITUDES
Farmers' Attitudes Toward Nonpoint Pollution Control and Participation in Cost-Share Programs,
W86-00782 5G

AUSTRALIA
Rain Estimation in Extratropical Cyclones Using GMS Imagery,
W86-00859 2B

BACTERIA
Distribution Pattern of Denitrifying Bacteria in Fish Ponds of Differing Farming Managements,
W86-00622 2H

Bacteriological Survey of Two Acid-Stressed Lakes in the Poconos before Limestone Application,
W86-00634 5C

Elimination of Viruses and Indicator Bacteria at Each Step of Treatment During Preparation of Drinking Water at Seven Water Treatment Plants,
W86-00775 5F

Rate of Bacterial Mortality in Aquatic Environments,
W86-00777 2A

Microbiological Quality of Recreational Waters in the Pacific Northwest,
W86-00840 5B

BACTERIAL
Bacterial Adsorption and Suspended Particles in Urban Stormwater,
W86-00842 5B

BACTERIAL TOXINS
Destroying Pyrogens in Water,
W86-00870 5F

BANK EROSION
Bank-Erosion Processes in a Cool-Temperate Environment, Orwell Lake, Minnesota,
W86-00898 2J

BARCELONA
Factors Influencing the High Content of Brominated Trihalomethanes in Barcelona's Water Supply (Spain),
W86-00727 5B

BARNACLES
Growth in Biomass of Balanus balanoides Young at Various Current Velocities,
W86-00721 2H

BASS
PCBs in Striped Bass Collected from the Hudson River, New York, During Fall, 1981,
W86-00695 5C

BATH COUNTY
Superhydro,
W86-00883 8A

BAYOU PLAQUEMINE-BRULE
Organochlorine Residues in Animals from Three Louisiana Watersheds in 1978 and 1979,
W86-00691 5B

BAYS
Effects of Treated Sewage Effluent and Bay-Bottom Mud on Growth of Marine Phytoplankton,
W86-00616 5C

BENTHIC FAUNA
Macrobenthic Invertebrates of a Perturbed Stream in Southern Nigeria,
W86-00652 5C

BENTHOS
Benthos-Plankton Relationship Upstream and Downstream of a Blackwater Impoundment,
W86-00620 6G

Organic Matter in Gravel Streams (Project RITRODAT-LUNZ),
W86-00913 2H

BINDING CAPACITY
Influence of pH on the Binding Capacity and Conditional Stability Constants of Aluminum and Naturally-Occurring Organic Matter,
W86-00773 2K

BIOACCUMULATION
Mercury Cycle in Lakes; Some New Hypotheses,
W86-00681 5B

Toxicity and Accumulation of Copper and Cadmium in the Alga Scenedesmus obliquus LH,
W86-00697 5C

BIOASSAY
Effect of Sulfite Dechlorination on the Accumulation of Waterborne Lead by Rainbow Trout (Salmo gairdneri),
W86-00615 5A

Testing for the Toxicity of Chemicals with Tetrahymena pyriformis,
W86-00711 5A

Aquatic Bioassay of 11 Pesticides Using Larvae of the Mosquito, Wyeomyia smithii (Diptera: Culicidae),
W86-00733 5A

Short-Term Test for Predicting the Potential of Xenobiotics to Impair Reproductive Success in Fish,
W86-00874 5A

BIOCHEMICAL OXYGEN DEMAND
Statistical Determination of the Optimal Sample Size of Secondary Effluent BOD5 and SS,
W86-00683 5A

Kinetic Analysis of BOD and Nitrogen Removal in an Oxidation Ditch,
W86-00755 5D

BIOFILTERS
Activated Biofilter Process for Wastewater Treatment,
W86-00871 5D

BIOINDICATORS
UV Inactivation of Pathogenic and Indicator Microorganisms,
W86-00774 5D

BIOLIMNOLOGY
Biolimnology of Harveys Lake,
W86-00633 2H

BIOLOGICAL TREATMENT
Biological Treatment of Landfill Leachates,
W86-00856 5D

Biological Removal of Phosphorus From Wastewater,
W86-00857 5D

BIOLOGICAL WASTEWATER TREATMENT
Removal of Soluble Substrates in Fixed Films,
W86-00734 5D

Effect of Load Fluctuations on the Effluent Concentration Produced by Fixed-Film Reactors,
W86-00736 5D

Elevated Nitrite Occurrence in Biological Wastewater Treatment Systems,
W86-00764 5D

Single Sludge Anoxic-Aerobic Systems for Biological Treatment of Coke Plant Wastewaters,
W86-00765 5D

BIOMASS
Growth in Biomass of Balanus balanoides Young at Various Current Velocities,
W86-00721 2H

Structured Modeling of the Anaerobic Digestion of Biomass Particulates,
W86-00848 5D

Performance of an Upflow Anaerobic Reactor Combining a Sludge Blanket and a Filter Treating Sugar Waste,
W86-00889 5D

BIOTIC INDEX
Chemical-Physical Changes Associated With Environmental Gradients in the Oka River Basin,
W86-00916 2H

BISMUTHIOL-II
Separation and Determination of Selenium(IV) in Environmental Water Samples by an Anion-Exchange Resin Modified with Bismuthiol-II and Diaminonaphthalene Fluorophotometry,
W86-00825 5A

BLACK CREEK
Benthos-Plankton Relationship Upstream and Downstream of a Blackwater Impoundment,
W86-00620 6G

BLACKLICK CREEK WATERSHED
Watershed Planning for Acid Mine Drainage Abatement,
W86-00787 4D

BLEACHING WASTES
Ion Exchange Potentially Effective in Reducing Effluent from Bleach Plant,
W86-00892 5D

BOTTOMLANDS
Bottomland Vegetation Distribution Along Passage Creek, Virginia, In Relation to Fluvial Landforms,
W86-00826 2H

BOUND MOISTURE
Determination of Moisture in Solids,
W86-00644 2G

BRAAN
Allium Test on River Water from Braan and Saxan Before and After Closure of a Chemical Factory,
W86-00667 5A

BRAZIL
Itaipu, South America's Grande Dame,
W86-00886 8A

BRITISH COLUMBIA
Stochastic Flood Analysis in a Region of Mixed Generating Processes,
W86-00646 2E

BROMINATED TRIHALOMETHANES
Factors Influencing the High Content of Brominated Trihalomethanes in Barcelona's Water Supply (Spain),
W86-00727 5B

BRUCE LAKE
Bacteriological Survey of Two Acid-Stressed Lakes in the Poconos before Limestone Application,
W86-00634 5C

BULRUSHES
Influence of Salinity on Scirpus americanus Tidal Marshes in the St. Lawrence River Estuary, Quebec,
W86-00902 2L

CADMIUM
Effects of Cadmium and Copper on Chemotaxis of Marine and Freshwater Ciliates,
W86-00696 5C

Toxicity and Accumulation of Copper and Cadmium in the Alga Scenedesmus obliquus LH,
W86-00697 5C

Mobility of Zinc, Cadmium, Copper, Lead, Iron and Arsenic in Ground Water as a Function of Redox Potential and pH,
W86-00706 5B

Effect of Aeration, Cadmium Concentration, and Solids Content on Acid Extraction of Cadmium from a Municipal Wastewater Sludge,
W86-00846 5D

CADMIUM SULFATE
Binding of Cadmium, Copper, and Lead Ions by Modified Cellulosic Materials,
W86-00692 5D

CALCIUM
Effects of Some Divalent Metals on Cardiac and Branchial Ca2+-ATPase in Freshwater Fish Saccobranchus fossilis,
W86-00880 5C

CALIFORNIA
Alluvial Fans: Novel Flood Challenge,
W86-00885 2E

Hydraulic Fill Dam Made Earthquake Resistant,
W86-00888 8A

CALUMET PUMPING STATION
What's Going on Under Chicago.
W86-00767 8A

CAPE MAY COUNTY
Enclosed Vessel Composting Begins at Cape May County,
W86-00713 5E

CARBAMATES
Microarray Electrochemical Flow Detectors at High Applied Potentials and Liquid Chromatography with Electrochemical Detection of Carbamate Pesticides in River Water,
W86-00820 7B

CARBOFURAN
Effect of Safe Concentrations of Some Pesticides on Ovarian Recrudescence in the Freshwater Murrel, Channa punctatus (Bl.): A Quantitative Study,
W86-00872 5C

CARBOHYDRATES
Effects of Available Dietary Carbohydrate and Water Temperature on the Chronic Toxicity of Waterborne Copper to Rainbow Trout (Salmo gairdneri),
W86-00630 5C

CARBON
Changes in Soil Carbon and Nitrogen Due to Irrigation Development in Nebraska's Sandhill Soils,
W86-00703 6G

Effect of Drought on Metabolism and Partitioning of Carbon in Two Wheat Varieties Differing in Drought-Tolerance,
W86-00907 2I

CARBON ADSORPTION ISOTHERM TEST
Carbon Adsorption Isotherm Test for Volatile Organic Chemicals in Water,
W86-00845 5A

CARBONIZED COAL PRODUCTS
Carbonized Coal Products as a Source of Aromatic Hydrocarbons to Sediments from a Highly Industrialized Estuary,
W86-00896 5B

CARBOZON
Alluvial Fans: Novel Flood Challenge,
W86-00885 2E

CARP
Effect of pH on Toxicity of Sodium Pentachlorophenate to Fry of Common Carp in Softwater,
W86-00626 5C

Studies on the Sequence of 2,6-Diisopropylnaphthalene Metabolite Formation Using Carp Hepatocyte,
W86-00879 5C

CESIUM RADIOISOTOPES
Distribution of gamma Exposure Rates In a Reactor Effluent Stream Flood Plain System,
W86-00821 5B

Radiocesium Levels in Irish Sea Fish and the Resulting Dose to the Population of the Irish Republic,
W86-00822 5B

CHANNEL MORPHOLOGY
Seepage-Limitation Optimization of the Shape of An Irrigation Channel by the Inverse Boundary-Value Problem Method,
W86-00869 3F

CHAPARRAL
Seasonal and Diurnal Water Relations Adjustments in Three Evergreen Chaparral Shrubs,
W86-00827 2I

CHEMICAL ANALYSIS
Chemical Study of the Shohola Creek Headwaters, Pike County, Pennsylvania,
W86-00636 5B

CHEMICAL COMPOSITION
Chemical Composition of Highway Drainage Waters; I. Major Ions and Selected Trace Metals,
W86-00708 5B

Chemical Composition of River Sediments from the Indian Sub-Continent,
W86-00771 2J

CHEMICAL SPECIATION
Chemical Composition of Highway Drainage Waters; III. Runoff Water Metal Speciation Characteristics,
W86-00710 5B

CHEMISTRY OF PRECIPITATION
Analysis of Precipitation Chemistry Data from Alaska,
W86-00659 2K

Effects of Storage on the Composition of Main Components in Rainwater Samples,
W86-00717 2K

Chemical Components in the Precipitation at Komoro and Tsukuba, Japan in 1983,
W86-00810 5B

CHEMOTAXIS
Effects of Cadmium and Copper on Chemotaxis of Marine and Freshwater Ciliates,
W86-00696 5C

CHESAPEAKE BAY
Historical Changes in Submerged Macrophyte Communities of Upper Chesapeake Bay,
W86-00828 2H

CHICAGO
What's Going on Under Chicago,
W86-00767 8A

CHINA (PEOPLES REPUBLIC)
Freshwater Aquaculture in China: Ecosystem Management for Survival,
W86-00664 2H

Hydrogeological Prospecting Group and Types of Mineral Deposits Filled with Karst Water in China (in Chinese).
W86-00897 2F

CHLORINATED HYDROCARBONS
Organochlorine Residues in Animals from Three Louisiana Watersheds in 1978 and 1979,
W86-00691 5B

Occurrence of Chlorinated Polynuclear Aromatic Hydrocarbons in Tap Water,
W86-00895 5B

CHLORINATED PHENOLS
Extraction and Enrichment of Chlorinated Phenols from Surface Waters for the Determination by Capillary-GC/FTIR-Spectroscopy,
W86-00824 5A

CHLORINE
Extent of Monochloramine Interference in the DPD Colorimetric Method for Free Chlorine in Water,
W86-00833 5A

CHLOROPHYLL
Comparison of the Phosphorus-Chlorophyll Relationships in Mixed and Stratified Lakes,
W86-00614 2H

Seasonal Cycles of Phytoplankton Populations and Total Chlorophyll of the Lower St. Johns River Estuary, Florida,
W86-00900 2L

CHROMATOGRAPHY
Ion Chromatograph Provides Rapid Analysis of Air and Water,
W86-00768 5A

CIRCLE QUADRANGLE
Gold-Mining Effects on Stream Hydrology and Water Quality, Circle Quadrangle, Alaska,
W86-00785 4C

Gold-Mining Effects on Heavy Metals in Streams, Circle Quadrangle, Alaska,
W86-00786 5C

CLEAN AIR ACT
Alternative Approaches to Acid Rain Control,
W86-00867 6E

CLEARWATER LAKE
Zinc Deposition in Acid Lakes: The Role of Diffusion,
W86-00689 5B

COAGULATION
Removal of Naturally Occurring Compounds by Coagulation and Sedimentation,
W86-00855 5F

COAL CONVERSION WASTEWATER
Batch Anaerobic Methanogensis of Phenolic Coal Conversion Wastewater,
W86-00743 5D

Lumped-Parameter Modeling of Multicomponent Adsorption in the Treatment of Coal-Conversion Wastewater by GAC,
W86-00815 5D

COASTAL WATERS
Potentially Toxic Blue-Green Algae (Cyanobacteria) in Finnish Natural Waters,
W86-00674 5B

COATINGS
Hydrous Fe and Mn Oxides - Scavengers of Heavy Metals in the Aquatic Environment,
W86-00852 5B

COKE PLANT WASTEWATER
Single Sludge Anoxic-Aerobic Systems for Biological Treatment of Coke Plant Wastewaters,
W86-00765 5D

COLLOIDS
Chemical Characterization of Estuarine Colloidal Organic Matter: Implications for Adsorptive Processes,
W86-00640 2L

COLOR
Statistical Model for Conversion of Absorbance Measurements with Significant Iron Interference into Organic Carbon in a Polyhumic Lake,
W86-00676 5A

COLORADO
Developing an Effective Storm Drainage Maintenance Program,
W86-00806 4A

COLORIMETRY
Extent of Monochloramine Interference in the DPD Colorimetric Method for Free Chlorine in Water,
W86-00833 5A

COMBINED SEWER OVERFLOWS
Factors Affecting Stream Transport of Combined Sewer Overflow Sediments,
W86-00843 5B

Use of a Swirl Concentrator for Combined Sewer Overflow Management,
W86-00844 5D

COMPACTED EARTH
Length and Slope Effects on Runoff from Sodium Dispersed, Compacted Earth Microcatchments,
W86-00705 3B

COMPOSTING
Enclosed Vessel Composting Begins at Cape May County,
W86-00713 5E

COMPUTER MODELS
Estimating Regional Snow Water Equivalent with a Simple Simulation Model,
W86-00789 2C

COMPUTERS
Assessment of Water Utility Information Systems and Their Use of Computers,
W86-00795 5F

CONOWINGO DAM
Additions to Ichthyofauna of the Susquehanna River with a Checklist of Fishes of the Susquehanna River Drainage below Conowingo Dam,
W86-00635 2H

CONSERVATION TILLAGE
Using Simulation to Assess the Impacts of Conservation Tillage on Movement of Sediment and Phosphorus into Lake Erie,
W86-00650 4D

Chemical and Stubble-Mulch Fallow Influences on Seasonal Soil Water Contents,
W86-00704 3F

CONSTANT-RATE PUMPING TESTS
Step-Drawdown and Constant-Rate Pumping Tests,
W86-00712 2F

CONTROLS
Use of Watershed Characteristics to Select Control Streams for Estimating Effects of Metal Mining Wastes on Extensively Disturbed Streams,
W86-00725 5C

COPPER
Effects of Available Dietary Carbohydrate and Water Temperature on the Chronic Toxicity of Waterborne Copper to Rainbow Trout (Salmo gairdneri),
W86-00630 5C

Growth Inhibition and Recovery in Mussels (Mytilus edulis) Exposed to Low Copper Concentrations,
W86-00668 5C

Effects of Cadmium and Copper on Chemotaxis of Marine and Freshwater Ciliates,
W86-00696 5C

Toxicity and Accumulation of Copper and Cadmium in the Alga Scenedesmus obliquus LH,
W86-00697 5C

Mobility of Zinc, Cadmium, Copper, Lead, Iron and Arsenic in Ground Water as a Function of Redox Potential and pH,
W86-00706 5B

Copper Toxicity to Cyanobacteria and its Dependence on Extracellular Ligand Concentration and Degradation,
W86-00910 5B

COPPER CHLORIDE
Binding of Cadmium, Copper, and Lead Ions by Modified Cellulosic Materials,
W86-00692 5D

COPRECIPITATION
Development of a New Process for Treating Uranium Mining Effluents,
W86-00759 5D

CORSICA
Variations in the Amount of Organic Carbon (Dissolved and Particulate) in a Small Mediterranean Mountain Stream (Corsica) (Les Variations des Teneurs en Carbone Organique (Dissous et Particulaire) d'un Petit Torrent Mediterraneen Montagnard (Corse)),
W86-00918 2H

COST SHARING
Farmers' Attitudes Toward Nonpoint Pollution Control and Participation in Cost-Share Programs,
W86-00782 5G

COSTS
Protecting Water Quality in the Midwest: Impact on Timber Harvesting Costs,
W86-00720 5D

Hydro-plant Upgrades Yield Reliable, Cost-effective Kilowatts,
W86-00804 8C

Survey Ties Needs to Water Quality,
W86-00838 5D

Innovative Water Management Plan Reduces Treatment Costs,
W86-00841 5D

Byzantine Art of Water Utility Ratemaking,
W86-00868 6C

CROSSED-JET SPILLWAYS
State of the Art on the Dimensioning of Spillways for Dams, Appendix: Crossed Jet Spillways (Etat des connaissances sur le dimensionnement des evacuateurs de crue des barrages, Annexe: Evacuateurs a jets croises),
W86-00655 8A

CRUSTACEANS
Percent Mortalities and LC50 Values for Selected Microcrustaceans Exposed to Treflan, Cutrine-plus, and MSMA Herbicides,
W86-00732 5C

CRYSTALLIZATION METHOD
Phosphorus Removal from Wastewater by the Crystallization Method,
W86-00741 5D

Phosphate Removal by Crystallization in a Fluidized Bed,
W86-00742 5D

CURRENT VELOCITY
Growth in Biomass of Balanus balanoides Young at Various Current Velocities,
W86-00721 2H

Effect of Velocity of Water Flow on Growth of Colonial Hydroids (Hydrozoa, Thecaphora),
W86-00722 2H

CUTRINE-PLUS
Percent Mortalities and LC50 Values for Selected Microcrustaceans Exposed to Treflan, Cutrine-plus, and MSMA Herbicides,
W86-00732 5C

CYANOPHYTA
Potentially Toxic Blue-Green Algae (Cyanobacteria) in Finnish Natural Waters,
W86-00674 5B

CYCLING NUTRIENTS
Phosphorus Spiralling in a Woodland Stream: Seasonal Variations,
W86-00830 2H

CYCLONES
Rain Estimation in Extratropical Cyclones Using GMS Imagery,
W86-00859 2B

CYPRESS CREEK WELL FIELD
Hydrologic and Vegetational Changes Resulting from Underground Pumping at the Cypress Creek Well Field, Pasco County, Florida,
W86-00899 6G

DAMS
Modelling Vibration and Vortex Formation at Piedra del Aguila,
W86-00800 8B

Superhydro,
W86-00883 8A

DAPHNIA
Acute and Chronic Toxicity of Technical Picloram (4-amino-3,5,6-trichloropicolinic acid) to Daphnia magna Straus,
W86-00731 5C

DDT
Separating Starvation Losses from Other Early Feeding Fry Mortality in Steelhead Trout Salmo gairdneri, Chinook Salmon Oncorhynchus tshawytscha, and Lake Trout Salvelinus namaycush,
W86-00728 5C

DECHLORINATION
Effect of Sulfite Dechlorination on the Accumulation of Waterborne Lead by Rainbow Trout (Salmo gairdneri),
W86-00615 5A

DECISION MAKING
Pollutant Runoff Models: Selection and Use in Decision Making,
W86-00780 5B

Simulation and Decisionmaking: The Platte River Basin in Nebraska,
W86-00790 6B

DECOMPOSITION
Factors Controlling Mass Loss and Nitrogen Dynamics of Plant Litter Decaying in Northern Streams,
W86-00637 2K

Spatial and Temporal Coupling of Nutrient Inputs to Estuarine Primary Production: The Role of Particulate Transport and Decomposition,
W86-00642 2L

DENITRIFICATION
Distribution Pattern of Denitrifying Bacteria in Fish Ponds of Differing Farming Managements,
W86-00622 2H

Modeling, Optimization and Design of Fluidized Beds for Biological Denitrification,
W86-00761 5D

Mathematical Model of Simultaneous Organic Oxidation, Nitrification, and Denitrification in Rotating Biological Contactors,
W86-00762 5D

DENSITY
Density of Precipitation Chemistry Networks,
W86-00684 7A

DESCHUTES RIVER BASIN
Modeling Hydroclimatic Processes in Large Watersheds,
W86-00647 2A

DESIGN CRITERIA
State of the Art on the Dimensioning of Spillways for Dams, Appendix: Crossed Jet Spillways (Etat des connaissances sur le dimensionnement des evacuateurs de crue des barrages, Annexe: Evacuateurs a jets croises),
W86-00655 8A

DETENTION RESERVOIRS
Proportional Weirs for Stormwater Pond Outlets,
W86-00887 8A

DETENTION TIME
Mixing and Detention Time Distribution in Activated Sludge Tanks,
W86-00747 5D

DETRITUS
Factors Controlling Mass Loss and Nitrogen Dynamics of Plant Litter Decaying in Northern Streams,
W86-00637 2K

Response of a Detrital Foodweb to Eutrophication,
W86-00638 5C

Alteration of Microbial Metabolic Activities in Association with Detritus,
W86-00639 2K

Dual-Gradient Concept of Detritus Transport and Processing in Estuaries,
W86-00641 2L

Hydrous Fe and Mn Oxides - Scavengers of Heavy Metals in the Aquatic Environment,
W86-00852 5B

DEVELOPING COUNTRIES
Drinking-water and Sanitation Projects: Criteria for Resource Allocation,
W86-00669 5F

Evaluating Pump Characteristics in Developing Countries,
W86-00884 8C

Economics of Erosion Control in a Subtropical Wastershed: A Dominican Case,
W86-00894 2J

DIATOMS
Relationships Between Surface Sediment Diatom Assemblages and Lakewater Characteristics in Adirondack Lakes,
W86-00829 2H

DICHLORVOS
Dichlorvos Intoxication in a Freshwater Prawn, Macrobrachium lamarrei (H. Milne Edwards),
W86-00882 5C

DIETHYL-P-PHENYLENE-DIAMINE
Extent of Monochloramine Interference in the DPD Colorimetric Method for Free Chlorine in Water,
W86-00833 5A

DIETS
Effects of Available Dietary Carbohydrate and Water Temperature on the Chronic Toxicity of

Waterborne Copper to Rainbow Trout (Salmo gairdneri),
W86-00630 5C

DIFFUSION
Zinc Deposition in Acid Lakes: The Role of Diffusion,
W86-00689 5B

DIISOPROPYLNAPHTHALENE
Studies on the Sequence of 2,6-Diisopropylnaphthalene Metabolite Formation Using Carp Hepatocyte,
W86-00879 5C

DISINFECTION
UV Inactivation of Pathogenic and Indicator Microorganisms,
W86-00774 5D

DISPERSION
Solute Dispersion During Axisymmetric Three-Dimensional Unsaturated Water Flow,
W86-00700 2G

DISSOLVED OXYGEN
Field-Use of Dissolved Oxygen Electrodes,
W86-00837 5A

Dissolved Oxygen Concentrations in Florida's Humic-Colored Waters and Water Quality Standard Implications,
W86-00901 5G

DISSOLVED SOLIDS
Influence of Particulate Organics on the Removal of Dissolved Organics in Fixed-Film Biological Reactors,
W86-00735 5D

Variations in the Amount of Organic Carbon (Dissolved and Particulate) in a Small Mediterranean Mountain Stream (Corsica) (Les Variations des Teneurs en Carbone Organique (Dissous et Particulaire) d'un Petit Torrent Mediterraneen Montagnard (Corse)),
W86-00918 2H

DIURNAL DISTRIBUTION
Seasonal and Diurnal Water Relations Adjustments in Three Evergreen Chaparral Shrubs,
W86-00827 2I

DOMINICAN REPUBLIC
Economics of Erosion Control in a Subtropical Wastershed: A Dominican Case,
W86-00894 2J

DOWNSLOPE LENGTH
Length and Slope Effects on Runoff from Sodium Dispersed, Compacted Earth Microcatchments,
W86-00705 3B

DRAINAGE
Quality of Runoff Water from Finnish Fuel Peat Mining Areas,
W86-00682 5B

Solute Discharge During Steady Water Drainage from a Sand Tank,
W86-00701 2G

DRAINAGE SYSTEMS
Developing an Effective Storm Drainage Maintenance Program,
W86-00806 4A

DRAINAGE WATER
Chemical Composition of Highway Drainage Waters; I. Major Ions and Selected Trace Metals,
W86-00708 5B

DRAINAGE WATERS
Chemical Composition of Highway Drainage Waters; II. Chemical Associations of Metals in the Suspended Sediment,
W86-00709 5B

Chemical Composition of Highway Drainage Waters; III. Runoff Water Metal Speciation Characteristics,
W86-00710 5B

DRIFT
Evaluation by Field Experiments of the McLay Model of Stream Drift,
W86-00628 2H

DRILLING MUD
Responses of Macrobenthos Colonizing Estuarine Sediments Contaminated with Drilling Mud Containing Diesel Oil,
W86-00730 5C

DRINKING WATER
Drinking-water and Sanitation Projects: Criteria for Resource Allocation,
W86-00669 5F

Mutagenicity Assessment of Different Drinking Water Supplies before and after Treatments,
W86-00690 5A

Elimination of Viruses and Indicator Bacteria at Each Step of Treatment During Preparation of Drinking Water at Seven Water Treatment Plants,
W86-00775 5F

Trends in Drinking Water Treatment The Shape of Things to Come,
W86-00805 5F

Utility Battles Iron and Manganese,
W86-00807 5F

City Implements Trihalomethane Control Program,
W86-00808 5F

Asbestos in Drinking Water
W86-00853 5B

Occurrence of Chlorinated Polynuclear Aromatic Hydrocarbons in Tap Water,
W86-00895 5B

DROUGHT RESISTANCE
Effect of Drought on Metabolism and Partitioning of Carbon in Two Wheat Varieties Differing in Drought-Tolerance,
W86-00907 2I

DROUGHT TOLERANCE
Effects of Drought on Partitioning of Nitrogen in Two Wheat Varieties Differing in Drought-Tolerance,
W86-00908 2I

DROUGHTS
Effect of Droughts on the Invertebrate Communities of High Mountain Streams,
W86-00915 2H

DRY DEPOSITION
Wet and Dry Deposition Monitoring in Southeastern Michigan,
W86-00719 5A

EARTHQUAKE ENGINEERING
Hydraulic Fill Dam Made Earthquake Resistant,
W86-00888 8A

EARTHWORMS
Effects of Municipal Sludge and Fertilizer on Heavy Metal Accumulation in Earthworms,
W86-00862 5C

EAST ASIA
Destruction of Water Resources - The Most Critical Ecological Crisis of East Asia,
W86-00666 4C

EAST FRANKLIN
Organochlorine Residues in Animals from Three Louisiana Watersheds in 1978 and 1979,
W86-00691 5B

ECOLOGICAL EFFECTS
Biological Consequences of Ice Rafting in a New England Salt Marsh Community,
W86-00627 2L

ECONOMIC ASPECTS
Alternative Solutions,
W86-00799 6C

Byzantine Art of Water Utility Ratemaking,
W86-00868 6C

ECOSYSTEMS
Long-Term Ecosystem Stress: The Effects of Years of Experimental Acidification on a Small Lake,
W86-00688 5C

EDTA
Binding of Cadmium, Copper, and Lead Ions by Modified Cellulosic Materials,
W86-00692 5D

EGYPT
Fossil Water under the Sinai-Negev Peninsula,
W86-00911 2F

ELECTROCHEMICAL FLOW DETECTORS
Microarray Electrochemical Flow Detectors at High Applied Potentials and Liquid Chromatography with Electrochemical Detection of Carbamate Pesticides in River Water,
W86-00820 7B

ELECTRODES
Field-Use of Dissolved Oxygen Electrodes,
W86-00837 5A

ENCLOSED VESSEL COMPOSTING
Enclosed Vessel Composting Begins at Cape May County,
W86-00713 5E

ENERGY BUDGET
Snowmelt Energy Budgets in Southern and East-Central Wisconsin,
W86-00648 2C

ENGLAND
Flotation that Might Sink,
W86-00831 6E

Large-Diameter Flexible Steel Pipes for the Transfer Works of the Kielder Water Scheme,
W86-00832 8G

Bulk Supply Scheme of the Mid Southern and North Surrey Water Companies,
W86-00835 3B

Environmental Impact of Paper Mill Waste Discharges to the Swale,
W86-00863 5C

Heavy Metal in Isopods from the Supra-Littoral Zone on the Southern Shore of the Severn Estuary, UK,
W86-00865 5B

ENRICHMENT FACTORS
Mathematical Model for Analysis of Sediment Core Data: Implications for Enrichment Factor Calculations and Trace-Metal Transport Mechanisms,
W86-00772 5B

ENVIRONMENTAL AUDIT
Environmental Audit. II. Application to Stream Network Design,
W86-00723 7A

ENVIRONMENTAL EFFECTS
Modeling the Cumulative Effects of Forest Practices on Downstream Aquatic Ecosystems,
W86-00651 6G

Net Benefit Model for Recreation Planning at Drinking Water Reservoirs,
W86-00792 6G

Addressing Social and Environmental Issues in Water Resources Planning and Management,
W86-00793 6A

Impact of Hydraulic Works on Water Quality, Part Two,
W86-00802 6G

Effects of Municipal Sludge and Fertilizer on Heavy Metal Accumulation in Earthworms,
W86-00862 5C

Hydrologic and Vegetational Changes Resulting from Underground Pumping at the Cypress Creek Well Field, Pasco County, Florida,
W86-00899 6G

Influence of Development of the River Widawka on the Ephemeroptera Fauna (Influence des Amenagements de la Riviere Widawka sur la Faune des Ephemeropteres),
W86-00914 5C

ENVIRONMENTAL GRADIENT
Chemical-Physical Changes Associated With Environmental Gradients in the Oka River Basin,
W86-00916 2H

ENVIRONMENTAL PROTECTION
Environmental Protection in the Republic of Ireland,
W86-00813 5G

Control of Metal Application Rates from Sewage Sludge Utilization in Agriculture,
W86-00854 5G

ENZYMES
Potential Use of Enzymes for Removal of Aromatic Compounds from Water,
W86-00753 5F

EQUALIZATION CONTROL
Equalization Control Strategy for Activated Sludge Process Control,
W86-00749 5D

EROSION CONTROL
Using Simulation to Assess the Impacts of Conservation Tillage on Movement of Sediment and Phosphorus into Lake Erie,
W86-00650 4D

Economics of Erosion Control in a Subtropical Watershed: A Dominican Case,
W86-00894 2J

ESTUARINE ENVIRONMENT
Effects of Treated Sewage Effluent and Bay-Bottom Mud on Growth of Marine Phytoplankton,
W86-00616 5C

Chemical Characterization of Estuarine Colloidal Organic Matter: Implications for Adsorptive Processes,
W86-00640 2L

Dual-Gradient Concept of Detritus Transport and Processing in Estuaries,
W86-00641 2L

Spatial and Temporal Coupling of Nutrient Inputs to Estuarine Primary Production: The Role of Particulate Transport and Decomposition,
W86-00642 2L

Responses of Macrobenthos Colonizing Estuarine Sediments Contaminated with Drilling Mud Containing Diesel Oil,
W86-00730 5C

Comparison of Several Methods for the Determination of Iron Hydroxides and Associated Orthophosphates in Estuarine Particulate Matter,
W86-00769 2L

EULERIAN MODELS
Eulerian Model for Scavenging of Pollutants by Raindrops,
W86-00718 5B

EUTROPHIC LAKES
Nutrient Fluxes in Eutrophic Coastal Louisiana Freshwater Lake,
W86-00724 2H

EUTROPHICATION
Effects of Treated Sewage Effluent and Bay-Bottom Mud on Growth of Marine Phytoplankton,
W86-00616 5C

Oligochaete Communities of the Sublittoral as Indicators of Lake Geneva Eutrophication,
W86-00624 5A

Response of a Detrital Foodweb to Eutrophication,
W86-00638 5C

EVALUATION
Evaluating Pump Characteristics in Developing Countries,
W86-00884 8C

FALLOW
Chemical and Stubble-Mulch Fallow Influences on Seasonal Soil Water Contents,
W86-00704 3F

FARMS
Farmers' Attitudes Toward Nonpoint Pollution Control and Participation in Cost-Share Programs,
W86-00782 5G

FATE OF POLLUTANTS
Fate and Effects of Organotin Compounds,
W86-00665 5B

Mercury Cycle in Lakes; Some New Hypotheses,
W86-00681 5B

Distribution and Persistence of Aminocarb in Stream Water, Sediment and Fish After Application of Three Matacil Formulations,
W86-00811 5B

Distribution of gamma Exposure Rates In a Reactor Effluent Stream Flood Plain System,
W86-00821 5B

Sorption of Mercury(II) by Humic Acids,
W86-00866 5B

Factors Influencing Hydrocarbon Degradation in Three Freshwater Lakes,
W86-00909 5B

FENITROTHION
Effect of Safe Concentrations of Some Pesticides on Ovarian Recrudescence in the Freshwater Murrel, Channa punctatus (Bl.): A Quantitative Study,
W86-00872 5C

FERTILIZER
Effects of Municipal Sludge and Fertilizer on Heavy Metal Accumulation in Earthworms,
W86-00862 5C

Primary/Secondary Sludge Recycled into Valuable Agricultural Fertilizer,
W86-00891 5E

FERTILIZERS
Land Application Systems For Municipal Sludge,
W86-00714 5E

FIELD TESTS
Field-Use of Dissolved Oxygen Electrodes,
W86-00837 5A

FILTRATION
New Conceptual Formulation for Predicting Filter Performance,
W86-00661 5D

FINLAND
Automatic Water Quality Monitoring in Rivers Exposed to Injurious Activities,
W86-00671 5A

Relations Between Phytoplankton and Environmental Factors in a Small, Spring-Meromictic Lake in Southern Finland,
W86-00672 2H

Potentially Toxic Blue-Green Algae (Cyanobacteria) in Finnish Natural Waters,
W86-00674 5B

Water Quality Model for Lake Kuortaneenjarvi, a Polyhumic Finnish Lake,
W86-00677 2H

Natural Occurrence of Pike-Perch (Stizostedion lucioperca (L.)) and Success of Introductions in Relation to Water Quality and Lake Area in Finland,
W86-00678 2H

Iodine Content of the Tissues of the Vendace (Coregonus albula L.) in Correlation to the Iodine Content of the Ambient Water,
W86-00679 2H

Pollution Loadings from Finnish Inland Fish-Farms: A Case Study,
W86-00680 5B

FISH
Distribution of Aluminum in the Tissues of Three Fish Species,
W86-00621 5C

Additions to Ichthyofauna of the Susquehanna River with a Checklist of Fishes of the Susquehanna River Drainage below Conowingo Dam,
W86-00635 2H

Method for Aquatic Multiple Species Toxicant Testing: Acute Toxicity of 10 Chemicals to 5 Vertebrates and 2 Invertebrates,
W86-00654 5A

Evidence for Polynuclear Aromatic Hydrocarbons in the Diet of Bottom-Feeding Fish,
W86-00694 5B

PCBs in Striped Bass Collected from the Hudson River, New York, During Fall, 1981,
W86-00695 5C

Distribution and Persistence of Aminocarb in Stream Water, Sediment and Fish After Application of Three Matacil Formulations,
W86-00811 5B

Radiocesium Levels in Irish Sea Fish and the Resulting Dose to the Population of the Irish Republic,
W86-00822 5B

Short-Term Test for Predicting the Potential of Xenobiotics to Impair Reproductive Success in Fish,
W86-00874 5A

FISH FARMING
Pollution Loadings from Finnish Inland Fish-Farms: A Case Study,
W86-00680 5B

FISH FOOD
Evidence for Polynuclear Aromatic Hydrocarbons in the Diet of Bottom-Feeding Fish,
W86-00694 5B

FISH HATCHERIES
Separating Starvation Losses from Other Early Feeding Fry Mortality in Steelhead Trout Salmo gairdneri, Chinook Salmon Oncorhynchus tshawytscha, and Lake Trout Salvelinus namaycush,
W86-00728 5C

FISH PHYSIOLOGY
Iodine Content of the Tissues of the Vendace (Coregonus albula L.) in Correlation to the Iodine Content of the Ambient Water,
W86-00679 2H

Mercury Cycle in Lakes; Some New Hypotheses,
W86-00681 5B

Fish Physiology and Metal Pollution: Results and Experiences from Laboratory and Field Studies,
W86-00873 5C

FISH PONDS
Distribution Pattern of Denitrifying Bacteria in Fish Ponds of Differing Farming Managements,
W86-00622 2H

FISH POPULATIONS
Natural Occurrence of Pike-Perch (Stizostedion lucioperca (L.)) and Success of Introductions in Relation to Water Quality and Lake Area in Finland,
W86-00678 2H

FISH TOXICANTS
Separating Starvation Losses from Other Early Feeding Fry Mortality in Steelhead Trout Salmo gairdneri, Chinook Salmon Oncorhynchus tshawytscha, and Lake Trout Salvelinus namaycush,
W86-00728 5C

FISHERIES
Freshwater Aquaculture in China: Ecosystem Management for Survival,
W86-00664 2H

FIXED FILM REACTORS
Removal of Soluble Substrates in Fixed Films,
W86-00734 5D

Influence of Particulate Organics on the Removal of Dissolved Organics in Fixed-Film Biological Reactors,
W86-00735 5D

Effect of Load Fluctuations on the Effluent Concentration Produced by Fixed-Film Reactors,
W86-00736 5D

FLEXIBLE MODELLING
Flexible Modelling of the Activated Sludge System - Theoretical and Practical Aspects,
W86-00751 5D

FLOOD ANALYSIS
Stochastic Flood Analysis in a Region of Mixed Generating Processes,
W86-00646 2E

FLOOD CONTROL
Monitoring Urban Waterways to Reduce Flood Damage and Ensure Public Safety,
W86-00687 4A

FLOOD-CONTROL DAMS
Invertebrate Colonization Rates in the Tailwater of a Kentucky Flood-Control Reservoir,
W86-00618 6G

FLOOD PLAIN MANAGEMENT
Alluvial Fans: Novel Flood Challenge,
W86-00885 2E

FLOODED SOIL
Persistence of Aldrin in Flooded Soil under the Cover of Rice,
W86-00875 5B

FLOODED SOILS
Nitrogen Transformations and Loss in Flooded Soils and Sediments,
W86-00849 2K

FLOODING
Effect of Flooding of Soil on Growth and Subsequent Responses of Taxodium distichum Seedlings to SO2,
W86-00861 5C

FLORENCE
Seismic Microactivity and Water Level Variation in Industrial Area near Florence (Italy),
W86-00632 2F

FLORIDA
Hydrologic and Vegetational Changes Resulting from Underground Pumping at the Cypress Creek Well Field, Pasco County, Florida,
W86-00899 6G

Seasonal Cycles of Phytoplankton Populations and Total Chlorophyll of the Lower St. Johns River Estuary, Florida,
W86-00900 2L

Dissolved Oxygen Concentrations in Florida's Humic-Colored Waters and Water Quality Standard Implications,
W86-00901 5G

FLOW INJECTION
Fluorimetric Determination of Trace Hydrogen Peroxide in Water with a Flow Injection System,
W86-00645 5A

FLUIDIZED BED PROCESS
Dynamics of Nitrification in a Biological Fluidized Bed Reactor,
W86-00760 5D

Modeling, Optimization and Design of Fluidized Beds for Biological Denitrification,
W86-00761 5D

FLUIDIZED BED REACTORS
Phosphate Removal by Crystallization in a Fluidized Bed,
W86-00742 5D

FLUORESCENCE
Remote Detection of Groundwater Contaminants Using Far-Ultraviolet Laser-Induced Fluorescence,
W86-00818 7B

FLUOROMETRY
Fluorimetric Determination of Trace Hydrogen Peroxide in Water with a Flow Injection System,
W86-00645 5A

FOOD CHAINS
Response of a Detrital Foodweb to Eutrophication,
W86-00638 5C

FORECASTING
Monitoring Urban Waterways to Reduce Flood Damage and Ensure Public Safety,
W86-00687 4A

Seasonal Precipitation Forecasting with a 6-7 Month Lead Time in the Pacific Northwest Using an Information Theoretic Model,
W86-00778 2B

FOREST MANAGEMENT
Modeling the Cumulative Effects of Forest Practices on Downstream Aquatic Ecosystems,
W86-00651 6G

Protecting Water Quality in the Midwest: Impact on Timber Harvesting Costs,
W86-00720 5D

FORESTS
New Rules for National Forest Water,
W86-00716 6D

FORT COLLINS
Developing an Effective Storm Drainage Maintenance Program,
W86-00806 4A

FOSSIL WATER
Fossil Water under the Sinai-Negev Peninsula,
W86-00911 2F

FOURIER-TRANSFORM INFRARED SPECTROSCOPY
Extraction and Enrichment of Chlorinated Phenols from Surface Waters for the Determination by Capillary-GC/FTIR-Spectroscopy,
W86-00824 5A

FRANCE
Variations in the Amount of Organic Carbon (Dissolved and Particulate) in a Small Mediterranean Mountain Stream (Corsica) (Les Variations des Teneurs en Carbone Organique (Dissous et Particulaire) d'un Petit Torrent Mediterraneen Montagnard (Corse)),
W86-00918 2H

FREE MOISTURE
Determination of Moisture in Solids,
W86-00644 2G

FUEL
Responses of Macrobenthos Colonizing Estuarine Sediments Contaminated with Drilling Mud Containing Diesel Oil,
W86-00730 5C

FUNDING
Barrier to Upgrading Funding,
W86-00797 6C

FUTURE PLANNING
Trends in Drinking Water Treatment The Shape of Things to Come,
W86-00805 5F

GAMMA RADIATION
Distribution of gamma Exposure Rates In a Reactor Effluent Stream Flood Plain System,
W86-00821 5B

GAS CHROMATOGRAPHY
Extraction and Enrichment of Chlorinated Phenols from Surface Waters for the Determination by Capillary-GC/FTIR-Spectroscopy,
W86-00824 5A

GEOHYDROLOGY
Hydrogeological Prospecting Group and Types of Mineral Deposits Filled with Karst Water in China (in Chinese).
W86-00897 2F

GEOTHERMAL FLUIDS
Removal of Arsenic from Geothermal Fluids by Adsorptive Bubble Flotation with Colloidal Ferric Hydroxide,
W86-00662 5D

GOLD MILL WASTES
Removal of Iron Cyanide from Gold Mill Effluents by Ion Exchange,
W86-00757 5D

GOLD MINING
Gold-Mining Effects on Stream Hydrology and Water Quality, Circle Quadrangle, Alaska,
W86-00785 4C

Gold-Mining Effects on Heavy Metals in Streams, Circle Quadrangle, Alaska,
W86-00786 5C

GOVERNING STABILITY
Simple Governing and Surging Simulation, Part One,
W86-00801 8B

GRANULAR ACTIVATED CARBON
Lumped-Parameter Modeling of Multicomponent Adsorption in the Treatment of Coal-Conversion Wastewater by GAC,
W86-00815 5D

GRASSLANDS
Factors Affecting Leaching of Nutrients from an Intensively Managed Grassland in County Antrim, Northern Ireland,
W86-00903 5B

GRAVEL STREAMS
Organic Matter in Gravel Streams (Project RITRODAT-LUNZ),
W86-00913 2H

GREEN RIVER BASIN
Salinity Issues and Water Development in the Green River Basin, Wyoming,
W86-00783 6E

GROUND TRUTH DATA
Surface Soil Water Content Measurement Using Pulsed Nuclear Magnetic Resonance Techniques,
W86-00698 2G

GROUNDNUT
Binding of Cadmium, Copper, and Lead Ions by Modified Cellulosic Materials,
W86-00692 5D

GROUNDWATER
Effect of Groundwater on Soil Formation in a Morainal Landscape in Saskatchewan,
W86-00670 2F

GROUNDWATER CONTAMINATION
Removing VOC from Groundwater; Pilot, Scale-up, and Operating Experience,
W86-00816 5F

Packed Tower Aeration Strips Trichloroethylene from Groundwater,
W86-00817 5F

Remote Detection of Groundwater Contaminants Using Far-Ultraviolet Laser-Induced Fluorescence,
W86-00818 7B

GROUNDWATER POLLUTION
Re-Evaluating the Extent of Groundwater Contamination,
W86-00686 5G

Mobility of Zinc, Cadmium, Copper, Lead, Iron and Arsenic in Ground Water as a Function of Redox Potential and pH,
W86-00706 5B

GROUNDWATER RECHARGE
Security of Groundwater Catchments Near Rivers; Charts to Determine the Variation in the Replenishment Flow (Surete des captages d'eau souterraine a proximite des rivieres; Abaques pour determiner l'evolution du debit de realimentation flow),
W86-00656 2F

GROUNDWATER SUPPLY
Re-Evaluating the Extent of Groundwater Contamination,
W86-00686 5G

GROUNDWATER WITHDRAWALS
Seismic Microactivity and Water Level Variation in Industrial Area near Florence (Italy),
W86-00632 2F

GUPPIES
Joint Toxicity of Mixtures of Groups of Organic Aquatic Pollutants to the Guppy (Poecilia reticulata),
W86-00876 5C

HARP LAKE CATCHMENT
Model of Sulphate Concentration in a Small Stream in the Harp Lake Catchment, Ontario,
W86-00629 5B

HARVEYS LAKE
Biolimnology of Harveys Lake,
W86-00633 2H

HEAD LOSS
New Conceptual Formulation for Predicting Filter Performance,
W86-00661 5D

HEAVY METALS
Heavy Metal Concentrations in Municipal Wastewater Treatment Plant Sludge,
W86-00726 5B

Gold-Mining Effects on Heavy Metals in Streams, Circle Quadrangle, Alaska,
W86-00786 5C

Hydrous Fe and Mn Oxides - Scavengers of Heavy Metals in the Aquatic Environment,
W86-00852 5B

Effects of Municipal Sludge and Fertilizer on Heavy Metal Accumulation in Earthworms,
W86-00862 5C

Heavy Metal in Isopods from the Supra-Littoral Zone on the Southern Shore of the Severn Estuary, UK,
W86-00865 5B

HEPATOCYTES
Studies on the Sequence of 2,6-Diisopropylnaphthalene Metabolite Formation Using Carp Hepatocyte,
W86-00879 5C

HERBICIDES
Acute and Chronic Toxicity of Technical Picloram (4-amino-3,5,6-trichloropicolinic acid) to Daphnia magna Straus,
W86-00731 5C

Percent Mortalities and LC50 Values for Selected Microcrustaceans Exposed to Treflan, Cutrine-plus, and MSMA Herbicides,
W86-00732 5C

HIBBING
Utility Battles Iron and Manganese,
W86-00807 5F

HIGHWAYS
Chemical Composition of Highway Drainage Waters; I. Major Ions and Selected Trace Metals,
W86-00708 5B

Chemical Composition of Highway Drainage Waters; II. Chemical Associations of Metals in the Suspended Sediment,
W86-00709 5B

Chemical Composition of Highway Drainage Waters; III. Runoff Water Metal Speciation Characteristics,
W86-00710 5B

HISTORY
Historical Changes in Submerged Macrophyte Communities of Upper Chesapeake Bay,
W86-00828 2H

HOLLOW DAMS
Itaipu, South America's Grande Dame,
W86-00886 8A

HONSHU ISLAND
Chemical Components in the Precipitation at Komoro and Tsukuba, Japan in 1983,
W86-00810 5B

HORNWORT
Sorptive Capacity of an Aquatic Macrophyte for the Pesticide Aminocarb,
W86-00812 5A

HUDSON RIVER
PCBs in Striped Bass Collected from the Hudson River, New York, During Fall, 1981,
W86-00695 5C

HUMIC ACIDS
Sorption of Mercury(II) by Humic Acids,
W86-00866 5B

HUMIC-COLORED WATERS
Dissolved Oxygen Concentrations in Florida's Humic-Colored Waters and Water Quality Standard Implications,
W86-00901 5G

HUMIC SUBSTANCES
Statistical Model for Conversion of Absorbance Measurements with Significant Iron Interference into Organic Carbon in a Polyhumic Lake,
W86-00676 5A

HYDRAULIC-FILL DAMS
Hydraulic Fill Dam Made Earthquake Resistant,
W86-00888 8A

HYDRAULIC STRUCTURES
Impact of Hydraulic Works on Water Quality, Part Two,
W86-00802 6G

HYDROCARBONS
Carbonized Coal Products as a Source of Aromatic Hydrocarbons to Sediments from a Highly Industrialized Estuary,
W86-00896 5B

Factors Influencing Hydrocarbon Degradation in Three Freshwater Lakes,
W86-00909 5B

HYDROELECTRIC PLANTS
Hydro-plant Upgrades Yield Reliable, Cost-effective Kilowatts,
W86-00804 8C

Superhydro,
W86-00883 8A

Itaipu, South America's Grande Dame,
W86-00886 8A

HYDROGEN ION CONCENTRATION
Mobility of Zinc, Cadmium, Copper, Lead, Iron and Arsenic in Ground Water as a Function of Redox Potential and pH,
W86-00706 5B

Influence of pH on the Binding Capacity and Conditional Stability Constants of Aluminum and Naturally-Occurring Organic Matter,
W86-00773 2K

Modification of a Metal Adsorption Model to Describe the Effect of pH,
W86-00847 5B

HYDROGEN ION CONNCENTRATION
Effect of pH on Toxicity of Sodium Pentachlorophenate to Fry of Common Carp in Softwater,
W86-00626 5C

HYDROGEN PEROXIDE
Fluorimetric Determination of Trace Hydrogen Peroxide in Water with a Flow Injection System,
W86-00645 5A

HYDROLOGIC MODELS
Modeling Hydroclimatic Processes in Large Watersheds,
W86-00647 2A

HYDROLOGICAL CYCLE
Destruction of Water Resources - The Most Critical Ecological Crisis of East Asia,
W86-00666 4C

HYDROLOGY
Filling in the Gap Between Hydrology and Hydrobiology - the Viewpoint of a Hydrologist,
W86-00675 2H

Gold-Mining Effects on Stream Hydrology and Water Quality, Circle Quadrangle, Alaska,
W86-00785 4C

Hydrologic and Vegetational Changes Resulting from Underground Pumping at the Cypress Creek Well Field, Pasco County, Florida,
W86-00899 6G

Abiotic and Hydrobiologic Characteristics of the Mediterranean Running Waters (Caracteristiques Abiotiques and Hydrobiologiques des Eaux Courantes Mediterraneennes),
W86-00919 2H

HYDROZOA
Effect of Velocity of Water Flow on Growth of Colonial Hydroids (Hydrozoa, Thecaphora),
W86-00722 2H

ICE RAFTING
Biological Consequences of Ice Rafting in a New England Salt Marsh Community,
W86-00627 2L

ICHTHYOCENOSIS
Dynamics of the Structure of the Ichthyocenosis of Lake Ubinskoye,
W86-00912 2H

IKPOBA RIVER
Macrobenthic Invertebrates of a Perturbed Stream in Southern Nigeria,
W86-00652 5C

ILLINOIS
What's Going on Under Chicago,
W86-00767 8A

In-Lake Water Quality Management Plan for a Recreational Lake in Central Illinois,
W86-00794 5G

INDIA
Studies of Water Pollution of the River Cauvery - Physico-Chemical Characteristics,
W86-00657 5B

Distribution of Heavy Metals in Water and Sediments of Selected Sites of Yamuna River (India); Environmental Monitoring of the Yamuna River - Part I,
W86-00685 5B

INDIAN SUBCONTINENT
Chemical Composition of River Sediments from the Indian Sub-Continent,
W86-00771 2J

INDUSTRIAL PLANTS
Storm Water Runoff from Industrial Sites,
W86-00766 5B

INDUSTRIAL WASTES
Influence of Oil Refinery Effluents on the Structure of Algal Communities,
W86-00623 5C

Allium Test on River Water from Braan and Saxan Before and After Closure of a Chemical Factory,
W86-00667 5A

INDUSTRIAL WASTEWATER
Sulfate Determination in Industrial Wastewater by Liquid Chromatography with Postcolumn Solid-Phase Reaction Detection,
W86-00819 5A

Environmental Impact of Paper Mill Waste Discharges to the Swale,
W86-00863 5C

Anaerobic Pretreatment Reduces Mill Costs, Improves Effluent Quality,
W86-00890 5D

Ion Exchange Potentially Effective in Reducing Effluent from Bleach Plant,
W86-00892 5D

Anaerobic Wastewater Treatment System Operates at Very Low Cost,
W86-00893 5D

INFRASTRUCTURE
Time and Institutional Requirements,
W86-00796 6F

Barrier to Upgrading Funding,
W86-00797 6C

Overcoming the Barriers,
W86-00798 6C

Alternative Solutions,
W86-00799 6C

INSECTICIDES
Distribution and Persistence of Aminocarb in Stream Water, Sediment and Fish After Application of Three Matacil Formulations,
W86-00811 5B

Sorptive Capacity of an Aquatic Macrophyte for the Pesticide Aminocarb,
W86-00812 5A

Microarray Electrochemical Flow Detectors at High Applied Potentials and Liquid Chromatography with Electrochemical Detection of Carbamate Pesticides in River Water,
W86-00820 7B

INVERSE BOUNDARY-VALUE METHOD
Seepage-Limitation Optimization of the Shape of An Irrigation Channel by the Inverse Boundary-Value Problem Method,
W86-00869 3F

INVERTEBRATES
Invertebrate Colonization Rates in the Tailwater of a Kentucky Flood-Control Reservoir,
W86-00618 6G

Macrobenthic Invertebrates of a Perturbed Stream in Southern Nigeria,
W86-00652 5C

Method for Aquatic Multiple Species Toxicant Testing: Acute Toxicity of 10 Chemicals to 5 Vertebrates and 2 Invertebrates,
W86-00654 5A

Effect of Droughts on the Invertebrate Communities of High Mountain Streams,
W86-00915 2H

IODINE
Iodine Content of the Tissues of the Vendace (Coregonus albula L.) in Correlation to the Iodine Content of the Ambient Water,
W86-00679 2H

ION CHROMATOGRAPHY
Ion Chromatograph Provides Rapid Analysis of Air and Water,
W86-00768 5A

ION EXCHANGE
Removal of Iron Cyanide from Gold Mill Effluents by Ion Exchange,
W86-00757 5D

Ion Exchange Potentially Effective in Reducing Effluent from Bleach Plant,
W86-00892 5D

IRELAND
Environmental Protection in the Republic of Ireland,
W86-00813 5G

Removal of Phosphate at Sewage Treatment Works and Implications on Phosphate Loadings into Lough Neagh,
W86-00834 5D

IRISH SEA
Radiocesium Levels in Irish Sea Fish and the Resulting Dose to the Population of the Irish Republic,
W86-00822 5B

IRON
Toxic Effects of Iron Ore Tailings and the Response of Watercress from Tailings at High Concentrations of Fe, Zn and Mn,
W86-00653 5C

Statistical Model for Conversion of Absorbance Measurements with Significant Iron Interference into Organic Carbon in a Polyhumic Lake,
W86-00676 5A

Mobility of Zinc, Cadmium, Copper, Lead, Iron and Arsenic in Ground Water as a Function of Redox Potential and pH,
W86-00706 5B

IRON CYANIDE
Removal of Iron Cyanide from Gold Mill Effluents by Ion Exchange,
W86-00757 5D

IRON HYDROXIDES
Comparison of Several Methods for the Determination of Iron Hydroxides and Associated Orthophosphates in Estuarine Particulate Matter,
W86-00769 2L

IRON OXIDES
Hydrous Fe and Mn Oxides - Scavengers of Heavy Metals in the Aquatic Environment,
W86-00852 5B

IRON REMOVAL
Utility Battles Iron and Manganese,
W86-00807 5F

IRRIGATION EFFECTS
Changes in Soil Carbon and Nitrogen Due to Irrigation Development in Nebraska's Sandhill Soils,
W86-00703 6G

IRRIGATION PRACTICE
Seepage-Limitation Optimization of the Shape of An Irrigation Channel by the Inverse Boundary-Value Problem Method,
W86-00869 3F

ISOPODS
Heavy Metal in Isopods from the Supra-Littoral Zone on the Southern Shore of the Severn Estuary, UK,
W86-00865 5B

ISRAEL
Fossil Water under the Sinai-Negev Peninsula,
W86-00911 2F

ITAIPU
Itaipu, South America's Grande Dame,
W86-00886 8A

ITALY
Seismic Microactivity and Water Level Variation in Industrial Area near Florence (Italy),
W86-00632 2F

JACKSON
City Implements Trihalomethane Control Program,
W86-00808 5F

JAPAN
Chemical Components in the Precipitation at Komoro and Tsukuba, Japan in 1983,
W86-00810 5B

Some Mire Systems in Japan,
W86-00904 2H

JAPANESE GEOSTATIONARY METEOROLOGICAL SATELLITE
Rain Estimation in Extratropical Cyclones Using GMS Imagery,
W86-00859 2B

JOHNSON SAUK TRAIL LAKE
In-Lake Water Quality Management Plan for a Recreational Lake in Central Illinois,
W86-00794 5G

KARST
Hydrogeological Prospecting Group and Types of Mineral Deposits Filled with Karst Water in China (in Chinese).
W86-00897 2F

KENTUCKY
Invertebrate Colonization Rates in the Tailwater of a Kentucky Flood-Control Reservoir,
W86-00618 6G

KENTUCKY RESERVOIR
Checklist of Phytoplankton (Exclusive of Diatoms) in Kentucky Reservoir,
W86-00631 2H

KIELDER WATER SCHEME
Large-Diameter Flexible Steel Pipes for the Transfer Works of the Kielder Water Scheme,
W86-00832 8G

KINETICS
Kinetic Studies of the Microbiological Conversion of Sulphate to Hydrogen Sulphide and Their Relevance to Sulphide Generation Within Sewers,
W86-00746 5D

Determination of Kinetic Constants of Activated Sludge Microorganisms,
W86-00752 5D

Kinetic Analysis of BOD and Nitrogen Removal in an Oxidation Ditch,
W86-00755 5D

LAC DES ALLEMANDS
Nutrient Fluxes in Eutrophic Coastal Louisiana Freshwater Lake,
W86-00724 2H

LAKE ERIE
Using Simulation to Assess the Impacts of Conservation Tillage on Movement of Sediment and Phosphorus into Lake Erie,
W86-00650 4D

Evidence for Polynuclear Aromatic Hydrocarbons in the Diet of Bottom-Feeding Fish,
W86-00694 5B

LAKE FISHERIES
Dynamics of the Structure of the Ichthyocenosis of Lake Ubinskoye,
W86-00912 2H

LAKE GENEVA
Oligochaete Communities of the Sublittoral as Indicators of Lake Geneva Eutrophication,
W86-00624 5A

LAKE KUORTANEENJARVI
Water Quality Model for Lake Kuortaneenjarvi, a Polyhumic Finnish Lake,
W86-00677 2H

LAKE MODELING
Lake Modeling: State of the Art,
W86-00850 2H

LAKE ONTOGENY
Accumulation of Sediment Organic Matter in a Hardwater Lake with Reference to Lake Ontogeny,
W86-00643 2J

LAKE RESTORATION
In-Lake Water Quality Management Plan for a Recreational Lake in Central Illinois,
W86-00794 5G

LAKE SEDIMENTS
Accumulation of Sediment Organic Matter in a Hardwater Lake with Reference to Lake Ontogeny,
W86-00643 2J

Zinc Deposition in Acid Lakes: The Role of Diffusion,
W86-00689 5B

Trace-Metal Concentrations in Sediments from Two Closed-Basin Lakes. Antarctica,
W86-00770 2H

Relationships Between Surface Sediment Diatom Assemblages and Lakewater Characteristics in Adirondack Lakes,
W86-00829 2H

LAKE UBINSKOYE
Dynamics of the Structure of the Ichthyocenosis of Lake Ubinskoye,
W86-00912 2H

LAKE VERRET
Organochlorine Residues in Animals from Three Louisiana Watersheds in 1978 and 1979,
W86-00691 5B

LAKES
Acidification of Southern Appalachian Lakes,
W86-00663 5B

General Lake Water Quality Index,
W86-00673 2H

Filling in the Gap Between Hydrology and Hydrobiology - the Viewpoint of a Hydrologist,
W86-00675 2H

Natural Occurrence of Pike-Perch (Stizostedion lucioperca (L.)) and Success of Introductions in Relation to Water Quality and Lake Area in Finland,
W86-00678 2H

Long-Term Ecosystem Stress: The Effects of Years of Experimental Acidification on a Small Lake,
W86-00688 5C

Use of Seepage Meters to Estimate Groundwater Nutrient Loading to Lakes,
W86-00788 7B

Factors Influencing Hydrocarbon Degradation in Three Freshwater Lakes,
W86-00909 5B

LAND APPLICATION
Land Application Systems For Municipal Sludge,
W86-00714 5E

LAND DISPOSAL
Effects of Municipal Sludge and Fertilizer on Heavy Metal Accumulation in Earthworms,
W86-00862 5C

Primary/Secondary Sludge Recycled into Valuable Agricultural Fertilizer,
W86-00891 5E

LANDFILLS
Biological Treatment of Landfill Leachates,
W86-00856 5D

LARVAE
Aquatic Bioassay of 11 Pesticides Using Larvae of the Mosquito, Wyeomyia smithii (Diptera: Culicidae),
W86-00733 5A

LEACHATES
Biological Treatment of Landfill Leachates,
W86-00856 5D

LEACHING
Factors Affecting Leaching of Nutrients from an Intensively Managed Grassland in County Antrim, Northern Ireland,
W86-00903 5B

LEAD
Effect of Sulfite Dechlorination on the Accumulation of Waterborne Lead by Rainbow Trout (Salmo gairdneri),
W86-00615 5A

Mobility of Zinc, Cadmium, Copper, Lead, Iron and Arsenic in Ground Water as a Function of Redox Potential and pH,
W86-00706 5B

LEAD NITRATE
Binding of Cadmium, Copper, and Lead Ions by Modified Cellulosic Materials,
W86-00692 5D

LEGAL ASPECTS
New Rules for National Forest Water,
W86-00716 6D

LEGISLATION
Environmental Protection in the Republic of Ireland,
W86-00813 5G

Alternative Approaches to Acid Rain Control,
W86-00867 6E

LIGANDS
Copper Toxicity to Cyanobacteria and its Dependence on Extracellular Ligand Concentration and Degradation,
W86-00910 5B

LIMNOLOGY
Lake Modeling: State of the Art,
W86-00850 2H

Limnology and Macrophyte Vegetation of a Deep, Clear Limestone Lake, Loch Borralie,
W86-00905 2H

LIQUID CHROMATOGRAPHY
Sulfate Determination in Industrial Wastewater by Liquid Chromatography with Postcolumn Solid-Phase Reaction Detection,
W86-00819 5A

Microarray Electrochemical Flow Detectors at High Applied Potentials and Liquid Chromatography with Electrochemical Detection of Carbamate Pesticides in River Water,
W86-00820 7B

LITERATURE REVIEW
Sludge Management: A Research Update,
W86-00715 5E

LITTORAL ZONE
Heavy Metal in Isopods from the Supra-Littoral Zone on the Southern Shore of the Severn Estuary, UK,
W86-00865 5B

LLOBREGAT RIVER
Factors Influencing the High Content of Brominated Trihalomethanes in Barcelona's Water Supply (Spain),
W86-00727 5B

LLOBREGAT RIVER BASIN
Patterns of Macroinvertebrate Distribution in the Llobregat River Basin (NE Spain),
W86-00917 2H

LOADING RATE
Effect of Load Fluctuations on the Effluent Concentration Produced by Fixed-Film Reactors,
W86-00736 5D

LOCH BORRALIE
Limnology and Macrophyte Vegetation of a Deep, Clear Limestone Lake, Loch Borralie,
W86-00905 2H

LOCHS
Aquatic Angiosperm Communities from Lochs on Rhum,
W86-00906 2H

LOTIC ENVIRONMENT
Abiotic and Hydrobiologic Characteristics of the Mediterranean Running Waters (Caracteristiques Abiotiques and Hydrobiologiques des Eaux Courantes Mediterraneennes),
W86-00919 2H

LOUGH NEAGH
Removal of Phosphate at Sewage Treatment Works and Implications on Phosphate Loadings into Lough Neagh,
W86-00834 5D

LOUISIANA
Organochlorine Residues in Animals from Three Louisiana Watersheds in 1978 and 1979,
W86-00691 5B

Nutrient Fluxes in Eutrophic Coastal Louisiana Freshwater Lake,
W86-00724 2H

LOW PRESSURE PIPE SEPTIC SYSTEMS
Sewage Effluent Pumps,
W86-00803 5D

LUMPED PARAMETER VALUE
Lumped-Parameter Modeling of Multicomponent Adsorption in the Treatment of Coal-Conversion Wastewater by GAC,
W86-00815 5D

MACROBENTHOS
Responses of Macrobenthos Colonizing Estuarine Sediments Contaminated with Drilling Mud Containing Diesel Oil,
W86-00730 5C

MACROINVERTEBRATES
Patterns of Macroinvertebrate Distribution in the Llobregat River Basin (NE Spain),
W86-00917 2H

MACROMIXING
Influence of Macromixing on Organic Carbon Uptake and Solids Production by Aerobic Suspended Biomass,
W86-00748 5D

MACROPHYTES
Sorptive Capacity of an Aquatic Macrophyte for the Pesticide Aminocarb,
W86-00812 5A

Limnology and Macrophyte Vegetation of a Deep, Clear Limestone Lake, Loch Borralie,
W86-00905 2H

Aquatic Angiosperm Communities from Lochs on Rhum,
W86-00906 2H

MAGNESIUM OXIDES
Hydrous Fe and Mn Oxides - Scavengers of Heavy Metals in the Aquatic Environment,
W86-00852 5B

MAINTENANCE
Developing an Effective Storm Drainage Maintenance Program,
W86-00806 4A

MANAGEMENT PLANNING
Alternative Solutions,
W86-00799 6C

MANGANESE
Toxic Effects of Iron Ore Tailings and the Response of Watercress from Tailings at High Concentrations of Fe, Zn and Mn,
W86-00653 5C

MANGANESE REMOVAL
Utility Battles Iron and Manganese,
W86-00807 5F

MAPS
Geographic Information Systems for Natural Resource Management,
W86-00649 7C

MARINE ANIMALS
Mercury Distribution in a Polluted Marine Area. Concentrations of Methyl Mercury in Sediments and Some Marine Organisms,
W86-00707 5A

MARINE ENVIRONMENT
Mercury Distribution in a Polluted Marine Area. Concentrations of Methyl Mercury in Sediments and Some Marine Organisms,
W86-00707 5A

MARYLAND
Additions to Ichthyofauna of the Susquehanna River with a Checklist of Fishes of the Susquehanna River Drainage below Conowingo Dam,
W86-00635 2H

Spatial and Temporal Coupling of Nutrient Inputs to Estuarine Primary Production: The Role of Particulate Transport and Decomposition,
W86-00642 2L

MATHEMATICAL MODELS
Evaluation by Field Experiments of the McLay Model of Stream Drift,
W86-00628 2H

Model of Sulphate Concentration in a Small Stream in the Harp Lake Catchment, Ontario,
W86-00629 5B

Mathematical Model of Simultaneous Organic Oxidation, Nitrification, and Denitrification in Rotating Biological Contactors,
W86-00762 5D

Mathematical Model for Analysis of Sediment Core Data: Implications for Enrichment Factor Calculations and Trace-Metal Transport Mechanisms,
W86-00772 5B

Application of Simple Moisture Accounting Models to Ungauged Catchments,
W86-00836 2E

Modification of a Metal Adsorption Model to Describe the Effect of pH,
W86-00847 5B

Structured Modeling of the Anaerobic Digestion of Biomass Particulates,
W86-00848 5D

MAYFLIES
Replacement of Stenonema spp. by Caenis diminuta Walker as the Numerical Dominant in the Mayfly Assemblage of a Thermally-Stressed Stream,
W86-00617 5C

Influence of Development of the River Widawka on the Ephemeroptera Fauna (Influence des Amenagements de la Riviere Widawka sur la Faune des Ephemeropteres),
W86-00914 5C

MCLAY MODEL
Evaluation by Field Experiments of the McLay Model of Stream Drift,
W86-00628 2H

MEASURING INSTRUMENTS
Surface Soil Water Content Measurement Using Pulsed Nuclear Magnetic Resonance Techniques,
W86-00698 2G

MEDITERRANEAN BASIN
Abiotic and Hydrobiologic Characteristics of the Mediterranean Running Waters (Caracteristiques Abiotiques and Hydrobiologiques des Eaux Courantes Mediterraneennes),
W86-00919 2H

MERCURIC CHLORIDE
In Vitro Effect of Mercuric Chloride on Acid and Alkaline Phosphatase Activity of a Freshwater Prawn,
W86-00625 5C

MERCURY
Mercury Cycle in Lakes; Some New Hypotheses,
W86-00681 5B

Sorption of Mercury(II) by Humic Acids,
W86-00866 5B

MEROMICTIC LAKES
Relations Between Phytoplankton and Environmental Factors in a Small, Spring-Meromictic Lake in Southern Finland,
W86-00672 2H

METABOLISM
Alteration of Microbial Metabolic Activities in Association with Detritus,
W86-00639 2K

Studies on the Sequence of 2,6-Diisopropylnaphthalene Metabolite Formation Using Carp Hepatocyte,
W86-00879 5C

Sublethal Effects of Simulated Pulp Mill Effluents on the Respiration and Energy Metabolism of Rainbow Trout (Salmo gairdneri),
W86-00881 5C

Effect of Drought on Metabolism and Partitioning of Carbon in Two Wheat Varieties Differing in Drought-Tolerance,
W86-00907 2I

METAL-FINISHING WASTES
Total Effluent Treatment and Rinse Water Reclamation in a Semiconductor Device Manufacturing Facility,
W86-00758 5D

METALS
Distribution of Heavy Metals in Water and Sediments of Selected Sites of Yamuna River (India); Environmental Monitoring of the Yamuna River - Part I,
W86-00685 5B

Chemical Composition of Highway Drainage Waters; II. Chemical Associations of Metals in the Suspended Sediment,
W86-00709 5B

Chemical Composition of Highway Drainage Waters; III. Runoff Water Metal Speciation Characteristics,
W86-00710 5B

Modification of a Metal Adsorption Model to Describe the Effect of pH,
W86-00847 5B

Control of Metal Application Rates from Sewage Sludge Utilization in Agriculture,
W86-00854 5G

Fish Physiology and Metal Pollution: Results and Experiences from Laboratory and Field Studies,
W86-00873 5C

Effects of Some Divalent Metals on Cardiac and Branchial Ca2+-ATPase in Freshwater Fish Saccobranchus fossilis,
W86-00880 5C

METHANOGENESIS
Batch Anaerobic Methanogensis of Phenolic Coal Conversion Wastewater,
W86-00743 5D

Methanogenesis in an Upflow Anaerobic Sludge Blanket Reactor at pH 6 on an Acetate-Propionate Mixture,
W86-00776 5D

METHYL MERCURY
Mercury Distribution in a Polluted Marine Area. Concentrations of Methyl Mercury in Sediments and Some Marine Organisms,
W86-00707 5A

METHYL PARATHION
Methyl Parathion (O-O-Dimethyl O-4-Nitrophenyl Thiophosphate) Effects on Whole-Body and Tissue Respiration in the Teleost, Tilapia mossambica (Peters),
W86-00878 5C

MICHIGAN
Wet and Dry Deposition Monitoring in Southeastern Michigan,
W86-00719 5A

MICROBIAL DEGRADATION
Factors Influencing Hydrocarbon Degradation in Three Freshwater Lakes,
W86-00909 5B

MICROCATCHMENTS
Length and Slope Effects on Runoff from Sodium Dispersed, Compacted Earth Microcatchments,
W86-00705 3B

MICROORGANISMS
Alteration of Microbial Metabolic Activities in Association with Detritus,
W86-00639 2K

Determination of Kinetic Constants of Activated Sludge Microorganisms,
W86-00752 5D

MINE WASTES
Toxic Effects of Iron Ore Tailings and the Response of Watercress from Tailings at High Concentrations of Fe, Zn and Mn,
W86-00653 5C

Use of Watershed Characteristics to Select Control Streams for Estimating Effects of Metal Mining Wastes on Extensively Disturbed Streams,
W86-00725 5C

Development of a New Process for Treating Uranium Mining Effluents,
W86-00759 5D

MINERALS
Hydrogeological Prospecting Group and Types of Mineral Deposits Filled with Karst Water in China (in Chinese).
W86-00897 2F

MINING
Quality of Runoff Water from Finnish Fuel Peat Mining Areas,
W86-00682 5B

Radiological Impact of Mining in a Th-Rich Norwegian Area,
W86-00823 5B

MINNESOTA
Utility Battles Iron and Manganese,
W86-00807 5F

Bank-Erosion Processes in a Cool-Temperate Environment, Orwell Lake, Minnesota,
W86-00898 2J

MINNOWS
Nitrite Exposure and Respiration Rates in Fathead Minnows,
W86-00729 5C

MIRES
Some Mire Systems in Japan,
W86-00904 2H

MISSISSIPPI
City Implements Trihalomethane Control Program,
W86-00808 5F

MIXED LAKES
Comparison of the Phosphorus-Chlorophyll Relationships in Mixed and Stratified Lakes,
W86-00614 2H

MIXING
Mixing and Detention Time Distribution in Activated Sludge Tanks,
W86-00747 5D

MODEL STUDIES
Modeling Hydroclimatic Processes in Large Watersheds,
W86-00647 2A

Modeling the Cumulative Effects of Forest Practices on Downstream Aquatic Ecosystems,
W86-00651 6G

Statistical Determination of the Optimal Sample Size of Secondary Effluent BOD5 and SS,
W86-00683 5A

Development of Pollutant Specific Models for Toxic Organic Compounds in the Activated Sludge Process,
W86-00754 5D

Modeling, Optimization and Design of Fluidized Beds for Biological Denitrification,
W86-00761 5D

Seasonal Precipitation Forecasting with a 6-7 Month Lead Time in the Pacific Northwest Using an Information Theoretic Model,
W86-00778 2B

Pollutant Runoff Models: Selection and Use in Decision Making,
W86-00780 5B

Net Benefit Model for Recreation Planning at Drinking Water Reservoirs,
W86-00792 6G

Lake Modeling: State of the Art,
W86-00850 2H

MOISTURE ACCOUNTING MODELS
Application of Simple Moisture Accounting Models to Ungauged Catchments,
W86-00836 2E

MONITORING
Automatic Water Quality Monitoring in Rivers Exposed to Injurious Activities,
W86-00671 5A

Wet and Dry Deposition Monitoring in Southeastern Michigan,
W86-00719 5A

MONOCHLORAMINE
Extent of Monochloramine Interference in the DPD Colorimetric Method for Free Chlorine in Water,
W86-00833 5A

MONOSODIUM METHANEARSONATE
Percent Mortalities and LC50 Values for Selected Microcrustaceans Exposed to Treflan, Cutrine-plus, and MSMA Herbicides,
W86-00732 5C

MONTE-CARLO PROCESS
Monte-Carlo Simulation of Noninteracting Solute Transport in a Spatially Heterogeneous Soil,
W86-00702 2G

MORAINES
Effect of Groundwater on Soil Formation in a Morainal Landscape in Saskatchewan,
W86-00670 2F

MORPHOMETRY
Filling in the Gap Between Hydrology and Hydrobiology - the Viewpoint of a Hydrologist,
W86-00675 2H

MORTALITY
Separating Starvation Losses from Other Early Feeding Fry Mortality in Steelhead Trout Salmo gairdneri, Chinook Salmon Oncorhynchus tshawytscha, and Lake Trout Salvelinus namaycush,
W86-00728 5C

Rate of Bacterial Mortality in Aquatic Environments,
W86-00777 2A

MOSQUITOS
Aquatic Bioassay of 11 Pesticides Using Larvae of the Mosquito, Wyeomyia smithii (Diptera: Culicidae),
W86-00733 5A

MOUNTAIN STREAMS
Variations in the Amount of Organic Carbon (Dissolved and Particulate) in a Small Mediterranean Mountain Stream (Corsica) (Les Variations des Teneurs en Carbone Organique (Dissous et Particulaire) d'un Petit Torrent Mediterraneen Montagnard (Corse)),
W86-00918 2H

MUNICIPAL WASTEWATER
Heavy Metal Concentrations in Municipal Wastewater Treatment Plant Sludge,
W86-00726 5B

MURRELS
Effect of Safe Concentrations of Some Pesticides on Ovarian Recrudescence in the Freshwater Murrel, Channa punctatus (Bl.): A Quantitative Study,
W86-00872 5C

MUSSELS
Growth Inhibition and Recovery in Mussels (Mytilus edulis) Exposed to Low Copper Concentrations,
W86-00668 5C

MUTAGENICITY
Mutagenicity Assessment of Different Drinking Water Supplies before and after Treatments,
W86-00690 5A

NATIONAL FORESTS
New Rules for National Forest Water,
W86-00716 6D

NEBRASKA
Changes in Soil Carbon and Nitrogen Due to Irrigation Development in Nebraska's Sandhill Soils,
W86-00703 6G

Simulation and Decisionmaking: The Platte River Basin in Nebraska,
W86-00790 6B

NEGEV DESERT
Fossil Water under the Sinai-Negev Peninsula,
W86-00911 2F

NETWORK DESIGN
Density of Precipitation Chemistry Networks,
W86-00684 7A

Environmental Audit. II. Application to Stream Network Design,
W86-00723 7A

NEW JERSEY
Enclosed Vessel Composting Begins at Cape May County,
W86-00713 5E

NEW YORK
PCBs in Striped Bass Collected from the Hudson River, New York, During Fall, 1981,
W86-00695 5C

Heavy Metal Concentrations in Municipal Wastewater Treatment Plant Sludge,
W86-00726 5B

Relationships Between Surface Sediment Diatom Assemblages and Lakewater Characteristics in Adirondack Lakes,
W86-00829 2H

NEW YORK BIGHT
Viral Pollution of the Marine Environment,
W86-00851 5B

NIGERIA
Macrobenthic Invertebrates of a Perturbed Stream in Southern Nigeria,
W86-00652 5C

NITRATES
Example of Interaction Between Environmental Pollutants: Modification of Thiram Toxicity to Freshwater Organisms by Nitrites or Nitrates in Relation to Nitrosamine Synthesis,
W86-00877 5C

NITRIFICATION
Dynamics of Nitrification in a Biological Fluidized Bed Reactor,
W86-00760 5D

Mathematical Model of Simultaneous Organic Oxidation, Nitrification, and Denitrification in Rotating Biological Contactors,
W86-00762 5D

NITRITES
Nitrite Exposure and Respiration Rates in Fathead Minnows,
W86-00729 5C

Elevated Nitrite Occurrence in Biological Wastewater Treatment Systems,
W86-00764 5D

Example of Interaction Between Environmental Pollutants: Modification of Thiram Toxicity to Freshwater Organisms by Nitrites or Nitrates in Relation to Nitrosamine Synthesis,
W86-00877 5C

NITROGEN
Factors Controlling Mass Loss and Nitrogen Dynamics of Plant Litter Decaying in Northern Streams,
W86-00637 2K

Changes in Soil Carbon and Nitrogen Due to Irrigation Development in Nebraska's Sandhill Soils,
W86-00703 6G

Nitrogen Transformations and Loss in Flooded Soils and Sediments,
W86-00849 2K

Effects of Drought on Partitioning of Nitrogen in Two Wheat Varieties Differing in Drought-Tolerance,
W86-00908 2I

NITROGEN REMOVAL
Influence of Extended Anaerobic Retention Time on the Performance of Phoredox Nutrient Removal Plants,
W86-00739 5D

Kinetic Analysis of BOD and Nitrogen Removal in an Oxidation Ditch,
W86-00755 5D

NITROSAMINES
Example of Interaction Between Environmental Pollutants: Modification of Thiram Toxicity to Freshwater Organisms by Nitrites or Nitrates in Relation to Nitrosamine Synthesis,
W86-00877 5C

NONPOINT POLLUTION SOURCES
Status of Nonpoint Source Pollution: Its Nature, Extent and Control,
W86-00779 5B

Farmers' Attitudes Toward Nonpoint Pollution Control and Participation in Cost-Share Programs,
W86-00782 5G

Environmental and Economic Damage Caused by Sediment from Agricultural Nonpoint Sources,
W86-00784 5C

NORTHERN IRELAND
Factors Affecting Leaching of Nutrients from an Intensively Managed Grassland in County Antrim, Northern Ireland,
W86-00903 5B

NORWAY
Radiological Impact of Mining in a Th-Rich Norwegian Area,
W86-00823 5B

NUCLEAR MAGNETIC RESONANCE
Surface Soil Water Content Measurement Using Pulsed Nuclear Magnetic Resonance Techniques,
W86-00698 2G

NUTRIENT SPIRALLING
Phosphorus Spiralling in a Woodland Stream: Seasonal Variations,
W86-00830 2H

NUTRIENTS
Spatial and Temporal Coupling of Nutrient Inputs to Estuarine Primary Production: The Role of Particulate Transport and Decomposition,
W86-00642 2L

Water Quality Model for Lake Kuortaneenjarvi, a Polyhumic Finnish Lake,
W86-00677 2H

Nutrient Fluxes in Eutrophic Coastal Louisiana Freshwater Lake,
W86-00724 2H

Use of Seepage Meters to Estimate Groundwater Nutrient Loading to Lakes,
W86-00788 7B

Factors Affecting Leaching of Nutrients from an Intensively Managed Grassland in County Antrim, Northern Ireland,
W86-00903 5B

OCEAN DUMPING
Viral Pollution of the Marine Environment,
W86-00851 5B

OKA RIVER BASIN
Chemical-Physical Changes Associated With Environmental Gradients in the Oka River Basin,
W86-00916 2H

OLIGOCHAETES
Oligochaete Communities of the Sublittoral as Indicators of Lake Geneva Eutrophication,
W86-00624 5A

OLIGOTROPHIC LAKES
Oligochaete Communities of the Sublittoral as Indicators of Lake Geneva Eutrophication,
W86-00624 5A

ONTARIO
Model of Sulphate Concentration in a Small Stream in the Harp Lake Catchment, Ontario,
W86-00629 5B

Monitoring Urban Waterways to Reduce Flood Damage and Ensure Public Safety,
W86-00687 4A

Zinc Deposition in Acid Lakes: The Role of Diffusion,
W86-00689 5B

OPTIMIZATION
Modeling, Optimization and Design of Fluidized Beds for Biological Denitrification,
W86-00761 5D

OREGON
Modeling Hydroclimatic Processes in Large Watersheds,
W86-00647 2A

Seasonal Precipitation Forecasting with a 6-7 Month Lead Time in the Pacific Northwest Using an Information Theoretic Model,
W86-00778 2B

ORGANIC CARBON
Influence of Macromixing on Organic Carbon Uptake and Solids Production by Aerobic Suspended Biomass,
W86-00748 5D

Variations in the Amount of Organic Carbon (Dissolved and Particulate) in a Small Mediterranean Mountain Stream (Corsica) (Les Variations des Teneurs en Carbone Organique (Dissous et Particulaire) d'un Petit Torrent Mediterraneen Montagnard (Corse)),
W86-00918 2H

ORGANIC COMPOUNDS
Development of Pollutant Specific Models for Toxic Organic Compounds in the Activated Sludge Process,
W86-00754 5D

Carbon Adsorption Isotherm Test for Volatile Organic Chemicals in Water,
W86-00845 5A

Joint Toxicity of Mixtures of Groups of Organic Aquatic Pollutants to the Guppy (Poecilia reticulata),
W86-00876 5C

ORGANIC MATTER
Chemical Characterization of Estuarine Colloidal Organic Matter: Implications for Adsorptive Processes,
W86-00640 2L

Accumulation of Sediment Organic Matter in a Hardwater Lake with Reference to Lake Ontogeny,
W86-00643 2J

Influence of Particulate Organics on the Removal of Dissolved Organics in Fixed-Film Biological Reactors,
W86-00735 5D

Influence of pH on the Binding Capacity and Conditional Stability Constants of Aluminum and Naturally-Occurring Organic Matter,
W86-00773 2K

Organic Matter in Gravel Streams (Project RI-TRODAT-LUNZ),
W86-00913 2H

ORGANIZATIONS
Flotation that Might Sink,
W86-00831 6E

ORGANOMERCURY COMPOUNDS
Mercury Cycle in Lakes; Some New Hypotheses,
W86-00681 5B

ORGANOTIN COMPOUNDS
Fate and Effects of Organotin Compounds,
W86-00665 5B

ORTHOPHOSPHATES
Comparison of Several Methods for the Determination of Iron Hydroxides and Associated Orthophosphates in Estuarine Particulate Matter,
W86-00769 2L

ORWELL LAKE
Bank-Erosion Processes in a Cool-Temperate Environment, Orwell Lake, Minnesota,
W86-00898 2J

OSMOTIC PRESSURE
Quantitative Structure-Toxicity Relationships with Osmotically Stressed Artemia salina Nauplii,
W86-00864 5C

OXIDATION
Mathematical Model of Simultaneous Organic Oxidation, Nitrification, and Denitrification in Rotating Biological Contactors,
W86-00762 5D

OXIDATION DITCH
Kinetic Analysis of BOD and Nitrogen Removal in an Oxidation Ditch,
W86-00755 5D

OXYGEN DEMAND
Anomalies Arising from Arbitrary Measures of the Strength of Sewage,
W86-00814 5D

OXYGEN TRANSFER RATE
Effect of Temperature on Oxygen Transfer Rate in Wastewater Treatment,
W86-00658 5D

OXYGENATION CAPACITY
Steady State Measurement of Oxygenation Capacity,
W86-00756 5D

OZONE
Destroying Pyrogens in Water,
W86-00870 5F

PALM OIL MILLS
Thermophilic Anaerobic Contact Digestion of Palm Oil Mill Effluent,
W86-00744 5D

PARAGUAY
Itaipu, South America's Grande Dame,
W86-00886 8A

PARANA RIVER
Itaipu, South America's Grande Dame,
W86-00886 8A

PARTICLE SIZE
Organic Matter in Gravel Streams (Project RI-TRODAT-LUNZ),
W86-00913 2H

PARTICULATE MATTER
Influence of Particulate Organics on the Removal of Dissolved Organics in Fixed-Film Biological Reactors,
W86-00735 5D

Comparison of Several Methods for the Determination of Iron Hydroxides and Associated Orthophosphates in Estuarine Particulate Matter,
W86-00769 2L

Variations in the Amount of Organic Carbon (Dissolved and Particulate) in a Small Mediterranean Mountain Stream (Corsica) (Les Variations des Teneurs en Carbone Organique (Dissous et Particulaire) d'un Petit Torrent Mediterraneen Montagnard (Corse)),
W86-00918 2H

PARTICULATE TRANSPORT
Spatial and Temporal Coupling of Nutrient Inputs to Estuarine Primary Production: The Role of Particulate Transport and Decomposition,
W86-00642 2L

PARTITION COEFFICIENTS
Quantitative Structure-Toxicity Relationships with Osmotically Stressed Artemia salina Nauplii,
W86-00864 5C

PARTITIONING
Effect of Drought on Metabolism and Partitioning of Carbon in Two Wheat Varieties Differing in Drought-Tolerance,
W86-00907 2I

Effects of Drought on Partitioning of Nitrogen in Two Wheat Varieties Differing in Drought-Tolerance,
W86-00908 2I

PASSAGE CREEK
Bottomland Vegetation Distribution Along Passage Creek, Virginia, In Relation to Fluvial Landforms,
W86-00826 2H

PATH OF POLLUTANTS
Pollutant Runoff Models: Selection and Use in Decision Making,
W86-00780 5B

Distribution and Persistence of Aminocarb in Stream Water, Sediment and Fish After Application of Three Matacil Formulations,
W86-00811 5B

PATHOGENS
UV Inactivation of Pathogenic and Indicator Microorganisms,
W86-00774 5D

PATUXENT RIVER
Spatial and Temporal Coupling of Nutrient Inputs to Estuarine Primary Production: The Role of Particulate Transport and Decomposition,
W86-00642 2L

PEAT
Quality of Runoff Water from Finnish Fuel Peat Mining Areas,
W86-00682 5B

PEAT BOGS
Some Mire Systems in Japan,
W86-00904 2H

PENNSYLVANIA
Biolimnology of Harveys Lake,
W86-00633 2H

Bacteriological Survey of Two Acid-Stressed Lakes in the Poconos before Limestone Application,
W86-00634 5C

Chemical Study of the Shohola Creek Headwaters, Pike County, Pennsylvania,
W86-00636 5B

Watershed Planning for Acid Mine Drainage Abatement,
W86-00787 4D

PERMITS
Innovative Water Quality-Based Permitting: A Policy Perspective,
W86-00839 5G

PESTICIDE TOXICITY
Effect of Safe Concentrations of Some Pesticides on Ovarian Recrudescence in the Freshwater Murrel, Channa punctatus (Bl.): A Quantitative Study,
W86-00872 5C

PESTICIDES
Organochlorine Residues in Animals from Three Louisiana Watersheds in 1978 and 1979,
W86-00691 5B

Aquatic Bioassay of 11 Pesticides Using Larvae of the Mosquito, Wyeomyia smithii (Diptera: Culicidae),
W86-00733 5A

PHOSPHORUS
Comparison of the Phosphorus-Chlorophyll Relationships in Mixed and Stratified Lakes,
W86-00614 2H

Using Simulation to Assess the Impacts of Conservation Tillage on Movement of Sediment and Phosphorus into Lake Erie,
W86-00650 4D

PHOSPHORUS RADIOISOTOPES
Phosphorus Spiralling in a Woodland Stream: Seasonal Variations,
W86-00830 2H

PHOSPHORUS REMOVAL
Role of an Anaerobic Stage on Biological Phosphorus Removal,
W86-00738 5D

Influence of Extended Anaerobic Retention Time on the Performance of Phoredox Nutrient Removal Plants,
W86-00739 5D

Location of Phosphorus in Activated Sludge and Function of Intracellular Polyphosphates in Biological Phosphorus Removal Process,
W86-00740 5D

Phosphorus Removal from Wastewater by the Crystallization Method,
W86-00741 5D

Phosphate Removal by Crystallization in a Fluidized Bed,
W86-00742 5D

Removal of Phosphate at Sewage Treatment Works and Implications on Phosphate Loadings into Lough Neagh,
W86-00834 5D

Biological Removal of Phosphorus From Wastewater,
W86-00857 5D

PHOTOCATALYSIS
Contaminant Degradation in Water,
W86-00660 5F

PHYSICOCHEMICAL CHARACTERISTICS
Studies of Water Pollution of the River Cauvery - Physico-Chemical Characteristics,
W86-00657 5B

Anomalies Arising from Arbitrary Measures of the Strength of Sewage,
W86-00814 5D

Chemical-Physical Changes Associated With Environmental Gradients in the Oka River Basin,
W86-00916 2H

PHYTOPLANKTON
Effects of Treated Sewage Effluent and Bay-Bottom Mud on Growth of Marine Phytoplankton,
W86-00616 5C

Checklist of Phytoplankton (Exclusive of Diatoms) in Kentucky Reservoir,
W86-00631 2H

Relations Between Phytoplankton and Environmental Factors in a Small, Spring-Meromictic Lake in Southern Finland,
W86-00672 2H

Seasonal Cycles of Phytoplankton Populations and Total Chlorophyll of the Lower St. Johns River Estuary, Florida,
W86-00900 2L

PICLORAM
Acute and Chronic Toxicity of Technical Picloram (4-amino-3,5,6-trichloropicolinic acid) to Daphnia magna Straus,
W86-00731 5C

PIEDRA DEL AGUILA
Modelling Vibration and Vortex Formation at Piedra del Aguila,
W86-00800 8B

PIKE COUNTY
Chemical Study of the Shohola Creek Headwaters, Pike County, Pennsylvania,
W86-00636 5B

PIKE-PERCH
Natural Occurrence of Pike-Perch (Stizostedion lucioperca (L.)) and Success of Introductions in Relation to Water Quality and Lake Area in Finland,
W86-00678 2H

PIPELINES
Large-Diameter Flexible Steel Pipes for the Transfer Works of the Kielder Water Scheme,
W86-00832 8G

PITCHER PLANTS
Aquatic Bioassay of 11 Pesticides Using Larvae of the Mosquito, Wyeomyia smithii (Diptera: Culicidae),
W86-00733 5A

PLANARIA
Metabolism of Aldrin by the Freshwater Planarian Phagocata gracilis,
W86-00693 5C

PLANKTON
Benthos-Plankton Relationship Upstream and Downstream of a Blackwater Impoundment,
W86-00620 6G

Biolimnology of Harveys Lake,
W86-00633 2H

PLANNING
Net Benefit Model for Recreation Planning at Drinking Water Reservoirs,
W86-00792 6G

Addressing Social and Environmental Issues in Water Resources Planning and Management,
W86-00793 6A

PLANT GROWTH
Effect of Flooding of Soil on Growth and Subsequent Responses of Taxodium distichum Seedlings to SO2,
W86-00861 5C

PLANT WATER POTENTIAL
Seasonal and Diurnal Water Relations Adjustments in Three Evergreen Chaparral Shrubs,
W86-00827 2I

PLATTE RIVER BASIN
Simulation and Decisionmaking: The Platte River Basin in Nebraska,
W86-00790 6B

PLECTONEMA
Copper Toxicity to Cyanobacteria and its Dependence on Extracellular Ligand Concentration and Degradation,
W86-00910 5B

POLAND
Influence of Development of the River Widawka on the Ephemeroptera Fauna (Influence des Amenagements de la Riviere Widawka sur la Faune des Ephemeropteres),
W86-00914 5C

Effect of Droughts on the Invertebrate Communities of High Mountain Streams,
W86-00915 2H

POLLUTANT IDENTIFICATION
Remote Detection of Groundwater Contaminants Using Far-Ultraviolet Laser-Induced Fluorescence,
W86-00818 7B

POLLUTION INDEX
General Lake Water Quality Index,
W86-00673 2H

POLYCHLORINATED BIPHENYLS
PCBs in Striped Bass Collected from the Hudson River, New York, During Fall, 1981,
W86-00695 5C

POLYHUMIC LAKES
Statistical Model for Conversion of Absorbance Measurements with Significant Iron Interference into Organic Carbon in a Polyhumic Lake,
W86-00676 5A

Water Quality Model for Lake Kuortaneenjarvi, a Polyhumic Finnish Lake,
W86-00677 2H

POLYNUCLEAR AROMATIC HYDROCARBONS
Evidence for Polynuclear Aromatic Hydrocarbons in the Diet of Bottom-Feeding Fish,
W86-00694 5B

Occurrence of Chlorinated Polynuclear Aromatic Hydrocarbons in Tap Water,
W86-00895 5B

Carbonized Coal Products as a Source of Aromatic Hydrocarbons to Sediments from a Highly Industrialized Estuary,
W86-00896 5B

POLYPHOSPHATES
Location of Phosphorus in Activated Sludge and Function of Intracellular Polyphosphates in Biological Phosphorus Removal Process,
W86-00740 5D

PONDING
Simulated Solute Movement in Wastewater-Ponded Soil,
W86-00699 5D

POPULATION DYNAMICS
Checklist of Phytoplankton (Exclusive of Diatoms) in Kentucky Reservoir,
W86-00631 2H

PRAWN
In Vitro Effect of Mercuric Chloride on Acid and Alkaline Phosphatase Activity of a Freshwater Prawn,
W86-00625 5C

Dichlorvos Intoxication in a Freshwater Prawn, Macrobrachium lamarrei (H. Milne Edwards),
W86-00882 5C

PRECIPITATION
Seasonal Precipitation Forecasting with a 6-7 Month Lead Time in the Pacific Northwest Using an Information Theoretic Model,
W86-00778 2B

Chemical Components in the Precipitation at Komoro and Tsukuba, Japan in 1983,
W86-00810 5B

PRECIPITATION CHEMISTRY
Density of Precipitation Chemistry Networks,
W86-00684 7A

PREDENITRIFICATION NITRIFICATION
Application of Predenitrification Nitrification Technology for Trace Contaminant Control,
W86-00763 5D

PRIMARY PRODUCTIVITY
Spatial and Temporal Coupling of Nutrient Inputs to Estuarine Primary Production: The Role of Particulate Transport and Decomposition,
W86-00642 2L

PRIVATIZATION
Flotation that Might Sink,
W86-00831 6E

PROCESS CONTROL
Equalization Control Strategy for Activated Sludge Process Control,
W86-00749 5D

PRODUCTIVITY
Effects of Sewage on Lake Champlain Wetland,
W86-00619 5C

PROPORTIONAL WEIRS
Proportional Weirs for Stormwater Pond Outlets,
W86-00887 8A

PROTOZOANS
Effects of Cadmium and Copper on Chemotaxis of Marine and Freshwater Ciliates,
W86-00696 5C

PUBLIC HEALTH
Drinking-water and Sanitation Projects: Criteria for Resource Allocation,
W86-00669 5F

Radiocesium Levels in Irish Sea Fish and the Resulting Dose to the Population of the Irish Republic,
W86-00822 5B

Viral Pollution of the Marine Environment,
W86-00851 5B

Asbestos in Drinking Water
W86-00853 5B

PUBLIC POLICY
Barrier to Upgrading Funding,
W86-00797 6C

Flotation that Might Sink,
W86-00831 6E

PULP AND PAPER INDUSTRY
Environmental Impact of Paper Mill Waste Discharges to the Swale,
W86-00863 5C

Anaerobic Pretreatment Reduces Mill Costs, Improves Effluent Quality,
W86-00890 5D

Ion Exchange Potentially Effective in Reducing Effluent from Bleach Plant,
W86-00892 5D

Anaerobic Wastewater Treatment System Operates at Very Low Cost,
W86-00893 5D

PULP WASTES
Sublethal Effects of Simulated Pulp Mill Effluents on the Respiration and Energy Metabolism of Rainbow Trout (Salmo gairdneri),
W86-00881 5C

PUMPED STORAGE
Superhydro,
W86-00883 8A

PUMPING STATIONS
What's Going on Under Chicago,
W86-00767 8A

PUMPING TESTS
Step-Drawdown and Constant-Rate Pumping Tests,
W86-00712 2F

PUMPS
Sewage Effluent Pumps,
W86-00803 5D

Evaluating Pump Characteristics in Developing Countries,
W86-00884 8C

PURIFICATION
Contaminant Degradation in Water,
W86-00660 5F

PYROGENS
Destroying Pyrogens in Water,
W86-00870 5F

QUEBEC
Zinc Deposition in Acid Lakes: The Role of Diffusion,
W86-00689 5B

Influence of Salinity on Scirpus americanus Tidal Marshes in the St. Lawrence River Estuary, Quebec,
W86-00902 2L

RADIATION
Radiocesium Levels in Irish Sea Fish and the Resulting Dose to the Population of the Irish Republic,
W86-00822 5B

RADIOISOTOPES
Radiological Impact of Mining in a Th-Rich Norwegian Area,
W86-00823 5B

RADIUM
Development of a New Process for Treating Uranium Mining Effluents,
W86-00759 5D

RAIN
Effects of Storage on the Composition of Main Components in Rainwater Samples,
W86-00717 2K

Eulerian Model for Scavenging of Pollutants by Raindrops,
W86-00718 5B

RAINFALL DISTRIBUTION
Rain Estimation in Extratropical Cyclones Using GMS Imagery,
W86-00859 2B

RAINFALL-RUNOFF RELATIONSHIPS
Modeling Hydroclimatic Processes in Large Watersheds,
W86-00647 2A

REACTION DETECTION
Sulfate Determination in Industrial Wastewater by Liquid Chromatography with Postcolumn Solid-Phase Reaction Detection,
W86-00819 5A

RECREATION
Net Benefit Model for Recreation Planning at Drinking Water Reservoirs,
W86-00792 6G

RECREATIONAL WATERS
Microbiological Quality of Recreational Waters in the Pacific Northwest,
W86-00840 5B

REDOX POTENTIAL
Mobility of Zinc, Cadmium, Copper, Lead, Iron and Arsenic in Ground Water as a Function of Redox Potential and pH,
W86-00706 5B

REFINERIES
Influence of Oil Refinery Effluents on the Structure of Algal Communities,
W86-00623 5C

REMOTE SENSING
Remote Detection of Groundwater Contaminants Using Far-Ultraviolet Laser-Induced Fluorescence,
W86-00818 7B

Rain Estimation in Extratropical Cyclones Using GMS Imagery,
W86-00859 2B

REMOVAL EFFFICIENCY
New Conceptual Formulation for Predicting Filter Performance,
W86-00661 5D

REPRODUCTION
Effect of Safe Concentrations of Some Pesticides on Ovarian Recrudescence in the Freshwater Murrel, Channa punctatus (Bl.): A Quantitative Study,
W86-00872 5C

Short-Term Test for Predicting the Potential of Xenobiotics to Impair Reproductive Success in Fish,
W86-00874 5A

RESERVOIRS
Benthos-Plankton Relationship Upstream and Downstream of a Blackwater Impoundment,
W86-00620 6G

Net Benefit Model for Recreation Planning at Drinking Water Reservoirs,
W86-00792 6G

Lake Modeling: State of the Art,
W86-00850 2H

RESINS
Separation and Determination of Selenium(IV) in Environmental Water Samples by an Anion-Exchange Resin Modified with Bismuthiol-II and Diaminonaphthalene Fluorophotometry,
W86-00825 5A

RESOURCES DEVELOPMENT
Geographic Information Systems for Natural Resource Management,
W86-00649 7C

RESPIRATION
Methyl Parathion (O-O-Dimethyl O-4-Nitrophenyl Thiophosphate) Effects on Whole-Body and Tissue Respiration in the Teleost, Tilapia mossambica (Peters),
W86-00878 5C

Sublethal Effects of Simulated Pulp Mill Effluents on the Respiration and Energy Metabolism of Rainbow Trout (Salmo gairdneri),
W86-00881 5C

RESPIRATION RATES
Nitrite Exposure and Respiration Rates in Fathead Minnows,
W86-00729 5C

RHUM
Aquatic Angiosperm Communities from Lochs on Rhum,
W86-00906 2H

RICE
Persistence of Aldrin in Flooded Soil under the Cover of Rice,
W86-00875 5B

RIVER CAUVERY
Studies of Water Pollution of the River Cauvery - Physico-Chemical Characteristics,
W86-00657 5B

RIVER SEDIMENTS
Chemical Composition of River Sediments from the Indian Sub-Continent,
W86-00771 2J

RIVERS
Automatic Water Quality Monitoring in Rivers Exposed to Injurious Activities,
W86-00671 5A

Flowing Water Resources,
W86-00791 2A

ROTATING BIOLOGICAL CONTACTORS
Mathematical Model of Simultaneous Organic Oxidation, Nitrification, and Denitrification in Rotating Biological Contactors,
W86-00762 5D

RUNOFF
Length and Slope Effects on Runoff from Sodium Dispersed, Compacted Earth Microcatchments,
W86-00705 3B

Chemical Composition of Highway Drainage Waters; III. Runoff Water Metal Speciation Characteristics,
W86-00710 5B

Storm Water Runoff from Industrial Sites,
W86-00766 5B

Pollutant Runoff Models: Selection and Use in Decision Making,
W86-00780 5B

Application of Simple Moisture Accounting Models to Ungauged Catchments,
W86-00836 2E

SACCOBRANCHUS
Effects of Some Divalent Metals on Cardiac and Branchial Ca2+-ATPase in Freshwater Fish Saccobranchus fossilis,
W86-00880 5C

SALINITY
Salinity Issues and Water Development in the Green River Basin, Wyoming,
W86-00783 6E

Influence of Salinity on Scirpus americanus Tidal Marshes in the St. Lawrence River Estuary, Quebec,
W86-00902 2L

SALMON
Separating Starvation Losses from Other Early Feeding Fry Mortality in Steelhead Trout Salmo gairdneri, Chinook Salmon Oncorhynchus tshawytscha, and Lake Trout Salvelinus namaycush,
W86-00728 5C

SALT LAKE CITY
Water for Salt Lake City,
W86-00809 3B

SALT MARSHES
Biological Consequences of Ice Rafting in a New England Salt Marsh Community,
W86-00627 2L

SAMPLE PRESERVATION
Effects of Storage on the Composition of Main Components in Rainwater Samples,
W86-00717 2K

SAN PABLO
Hydraulic Fill Dam Made Earthquake Resistant,
W86-00888 8A

SANITATION
Drinking-water and Sanitation Projects: Criteria for Resource Allocation,
W86-00669 5F

SASKATCHEWAN
Effect of Groundwater on Soil Formation in a Morainal Landscape in Saskatchewan,
W86-00670 2F

SAXAN
Allium Test on River Water from Braan and Saxan Before and After Closure of a Chemical Factory,
W86-00667 5A

SCAVENGING
Eulerian Model for Scavenging of Pollutants by Raindrops,
W86-00718 5B

SCENEDESMUS
Toxicity and Accumulation of Copper and Cadmium in the Alga Scenedesmus obliquus LH,
W86-00697 5C

SCOTLAND
Limnology and Macrophyte Vegetation of a Deep, Clear Limestone Lake, Loch Borralie,
W86-00905 2H

Aquatic Angiosperm Communities from Lochs on Rhum,
W86-00906 2H

SEASONAL VARIATION
Seasonal and Diurnal Water Relations Adjustments in Three Evergreen Chaparral Shrubs,
W86-00827 2I

Phosphorus Spiralling in a Woodland Stream: Seasonal Variations,
W86-00830 2H

Seasonal Cycles of Phytoplankton Populations and Total Chlorophyll of the Lower St. Johns River Estuary, Florida,
W86-00900 2L

SEDIMENT
Distribution and Persistence of Aminocarb in Stream Water, Sediment and Fish After Application of Three Matacil Formulations,
W86-00811 5B

SEDIMENT CORES
Historical Changes in Submerged Macrophyte Communities of Upper Chesapeake Bay,
W86-00828 2H

SEDIMENT TRANSPORT
Using Simulation to Assess the Impacts of Conservation Tillage on Movement of Sediment and Phosphorus into Lake Erie,
W86-00650 4D

Factors Affecting Stream Transport of Combined Sewer Overflow Sediments,
W86-00843 5B

SEDIMENT-WATER INTERFACES
Zinc Deposition in Acid Lakes: The Role of Diffusion,
W86-00689 5B

SEDIMENTATION
Factors Affecting Stream Transport of Combined Sewer Overflow Sediments,
W86-00843 5B

Removal of Naturally Occurring Compounds by Coagulation and Sedimentation,
W86-00855 5F

SEDIMENTS
Effects of Treated Sewage Effluent and Bay-Bottom Mud on Growth of Marine Phytoplankton,
W86-00616 5C

Distribution of Heavy Metals in Water and Sediments of Selected Sites of Yamuna River (India); Environmental Monitoring of the Yamuna River - Part I,
W86-00685 5B

Mercury Distribution in a Polluted Marine Area. Concentrations of Methyl Mercury in Sediments and Some Marine Organisms,
W86-00707 5A

Responses of Macrobenthos Colonizing Estuarine Sediments Contaminated with Drilling Mud Containing Diesel Oil,
W86-00730 5C

Mathematical Model for Analysis of Sediment Core Data: Implications for Enrichment Factor Calculations and Trace-Metal Transport Mechanisms,
W86-00772 5B

Environmental and Economic Damage Caused by Sediment from Agricultural Nonpoint Sources,
W86-00784 5C

Nitrogen Transformations and Loss in Flooded Soils and Sediments,
W86-00849 2K

Carbonized Coal Products as a Source of Aromatic Hydrocarbons to Sediments from a Highly Industrialized Estuary,
W86-00896 5B

SEEDS
Historical Changes in Submerged Macrophyte Communities of Upper Chesapeake Bay,
W86-00828 2H

SEEPAGE
Use of Seepage Meters to Estimate Groundwater Nutrient Loading to Lakes,
W86-00788 7B

Seepage-Limitation Optimization of the Shape of An Irrigation Channel by the Inverse Boundary-Value Problem Method,
W86-00869 3F

SEEPAGE METERS
Use of Seepage Meters to Estimate Groundwater Nutrient Loading to Lakes,
W86-00788 7B

SEISMOLOGY
Seismic Microactivity and Water Level Variation in Industrial Area near Florence (Italy),
W86-00632 2F

SELENIUM
Separation and Determination of Selenium(IV) in Environmental Water Samples by an Anion-Exchange Resin Modified with Bismuthiol-II and Diaminonaphthalene Fluorophotometry,
W86-00825 5A

SELLAFIELD
Radiocesium Levels in Irish Sea Fish and the Resulting Dose to the Population of the Irish Republic,
W86-00822 5B

SEMICONDUCTOR INDUSTRY
Total Effluent Treatment and Rinse Water Reclamation in a Semiconductor Device Manufacturing Facility,
W86-00758 5D

SEPTIC TANKS
Sewage Effluent Pumps,
W86-00803 5D

SEVERN ESTUARY
Heavy Metal in Isopods from the Supra-Littoral Zone on the Southern Shore of the Severn Estuary, UK,
W86-00865 5B

SEWERS
Kinetic Studies of the Microbiological Conversion of Sulphate to Hydrogen Sulphide and

Their Relevance to Sulphide Generation Within Sewers,
W86-00746 5D

SHOHOLA CREEK
Chemical Study of the Shohola Creek Headwaters, Pike County, Pennsylvania,
W86-00636 5B

SHRIMP
Quantitative Structure-Toxicity Relationships with Osmotically Stressed Artemia salina Nauplii,
W86-00864 5C

SIMULATION
Water Quality Model for Lake Kuortaneenjarvi, a Polyhumic Finnish Lake,
W86-00677 2H

Simulated Solute Movement in Wastewater-Ponded Soil,
W86-00699 5D

Monte-Carlo Simulation of Noninteracting Solute Transport in a Spatially Heterogeneous Soil,
W86-00702 2G

Estimating Regional Snow Water Equivalent with a Simple Simulation Model,
W86-00789 2C

Simulation and Decisionmaking: The Platte River Basin in Nebraska,
W86-00790 6B

Simple Governing and Surging Simulation, Part One,
W86-00801 8B

SINAI DESERT
Fossil Water under the Sinai-Negev Peninsula,
W86-00911 2F

SINGLE SLUDGE PROCESS
Single Sludge Anoxic-Aerobic Systems for Biological Treatment of Coke Plant Wastewaters,
W86-00765 5D

SLOPE
Length and Slope Effects on Runoff from Sodium Dispersed, Compacted Earth Microcatchments,
W86-00705 3B

SLUDGE
Sludge Management: A Research Update,
W86-00715 5E

Heavy Metal Concentrations in Municipal Wastewater Treatment Plant Sludge,
W86-00726 5B

Effect of Aeration, Cadmium Concentration, and Solids Content on Acid Extraction of Cadmium from a Municipal Wastewater Sludge,
W86-00846 5D

SLUDGE DISPOSAL
Land Application Systems For Municipal Sludge,
W86-00714 5E

Viral Pollution of the Marine Environment,
W86-00851 5B

Control of Metal Application Rates from Sewage Sludge Utilization in Agriculture,
W86-00854 5G

Effects of Municipal Sludge and Fertilizer on Heavy Metal Accumulation in Earthworms,
W86-00862 5C

Primary/Secondary Sludge Recycled into Valuable Agricultural Fertilizer,
W86-00891 5E

SNOW COVER
Influences of Snow Cover and Soil Moisture on Monthly Air Temperature,
W86-00860 2A

SNOWMELT
Snowmelt Energy Budgets in Southern and East-Central Wisconsin,
W86-00648 2C

SNOWPACK
Estimating Regional Snow Water Equivalent with a Simple Simulation Model,
W86-00789 2C

SOCIAL ASPECTS
Addressing Social and Environmental Issues in Water Resources Planning and Management,
W86-00793 6A

SODIUM PENTACHLOROPHENATE
Effect of pH on Toxicity of Sodium Pentachlorophenate to Fry of Common Carp in Softwater,
W86-00626 5C

SOIL CHEMISTRY
Changes in Soil Carbon and Nitrogen Due to Irrigation Development in Nebraska's Sandhill Soils,
W86-00703 6G

Effect of Acid Rain on Soils,
W86-00858 5C

SOIL CONSERVATION
Economics of Erosion Control in a Subtropical Watershed: A Dominican Case,
W86-00894 2J

SOIL GENESIS
Effect of Groundwater on Soil Formation in a Morainal Landscape in Saskatchewan,
W86-00670 2F

SOIL WATER
Determination of Moisture in Solids,
W86-00644 2G

Surface Soil Water Content Measurement Using Pulsed Nuclear Magnetic Resonance Techniques,
W86-00698 2G

Monte-Carlo Simulation of Noninteracting Solute Transport in a Spatially Heterogeneous Soil,
W86-00702 2G

Influences of Snow Cover and Soil Moisture on Monthly Air Temperature,
W86-00860 2A

Effect of Flooding of Soil on Growth and Subsequent Responses of Taxodium distichum Seedlings to SO2,
W86-00861 5C

SOIL WATER CONTENT
Chemical and Stubble-Mulch Fallow Influences on Seasonal Soil Water Contents,
W86-00704 3F

SOLUTE TRANSPORT
Simulated Solute Movement in Wastewater-Ponded Soil,
W86-00699 5D

Solute Dispersion During Axisymmetric Three-Dimensional Unsaturated Water Flow,
W86-00700 2G

Solute Discharge During Steady Water Drainage from a Sand Tank,
W86-00701 2G

Monte-Carlo Simulation of Noninteracting Solute Transport in a Spatially Heterogeneous Soil,
W86-00702 2G

SORPTION
Sorptive Capacity of an Aquatic Macrophyte for the Pesticide Aminocarb,
W86-00812 5A

SOUTH CAROLINA
Benthos-Plankton Relationship Upstream and Downstream of a Blackwater Impoundment,
W86-00620 6G

SPAIN
Factors Influencing the High Content of Brominated Trihalomethanes in Barcelona's Water Supply (Spain),
W86-00727 5B

Chemical-Physical Changes Associated With Environmental Gradients in the Oka River Basin,
W86-00916 2H

Patterns of Macroinvertebrate Distribution in the Llobregat River Basin (NE Spain),
W86-00917 2H

SPATIAL DISTRIBUTION
Patterns of Macroinvertebrate Distribution in the Llobregat River Basin (NE Spain),
W86-00917 2H

SPECIES COMPOSITION
Replacement of Stenonema spp. by Caenis diminuta Walker as the Numerical Dominant in the Mayfly Assemblage of a Thermally-Stressed Stream,
W86-00617 5C

Relationships Between Surface Sediment Diatom Assemblages and Lakewater Characteristics in Adirondack Lakes,
W86-00829 2H

Patterns of Macroinvertebrate Distribution in the Llobregat River Basin (NE Spain),
W86-00917 2H

SPILLWAYS
State of the Art on the Dimensioning of Spillways for Dams, Appendix: Crossed Jet Spillways (Etat des connaissances sur le dimensionnement des evacuateurs de crue des barrages, Annexe: Evacuateurs a jets croises),
W86-00655 8A

ST. JOHNS RIVER ESTUARY
Seasonal Cycles of Phytoplankton Populations and Total Chlorophyll of the Lower St. Johns River Estuary, Florida,
W86-00900 2L

ST. LAWRENCE RIVER ESTUARY
Influence of Salinity on Scirpus americanus Tidal Marshes in the St. Lawrence River Estuary, Quebec,
W86-00902 2L

STABILITY CONSTANTS
Influence of pH on the Binding Capacity and Conditional Stability Constants of Aluminum and Naturally-Occurring Organic Matter,
W86-00773 2K

STARVATION
Separating Starvation Losses from Other Early Feeding Fry Mortality in Steelhead Trout Salmo gairdneri, Chinook Salmon Oncorhynchus tshawytscha, and Lake Trout Salvelinus namaycush,
W86-00728 5C

STATISTICAL MODELS
Statistical Model for Conversion of Absorbance Measurements with Significant Iron Interference into Organic Carbon in a Polyhumic Lake,
W86-00676 5A

STEADY STATE MEASUREMENT
Steady State Measurement of Oxygenation Capacity,
W86-00756 5D

STEP-DRAWDOWN TESTS
Step-Drawdown and Constant-Rate Pumping Tests,
W86-00712 2F

STOCHASTIC HYDROLOGY
Stochastic Flood Analysis in a Region of Mixed Generating Processes,
W86-00646 2E

STOMACHS
Evidence for Polynuclear Aromatic Hydrocarbons in the Diet of Bottom-Feeding Fish,
W86-00694 5B

STORM DRAINS
Developing an Effective Storm Drainage Maintenance Program,
W86-00806 4A

STORM RUNOFF
Storm Water Runoff from Industrial Sites,
W86-00766 5B

Proportional Weirs for Stormwater Pond Outlets,
W86-00887 8A

STRATIFIED LAKES
Comparison of the Phosphorus-Chlorophyll Relationships in Mixed and Stratified Lakes,
W86-00614 2H

STREAM BIOTA
Evaluation by Field Experiments of the McLay Model of Stream Drift,
W86-00628 2H

STREAM POLLUTION
Gold-Mining Effects on Heavy Metals in Streams, Circle Quadrangle, Alaska,
W86-00786 5C

STREAMS
Model of Sulphate Concentration in a Small Stream in the Harp Lake Catchment, Ontario,
W86-00629 5B

Factors Controlling Mass Loss and Nitrogen Dynamics of Plant Litter Decaying in Northern Streams,
W86-00637 2K

Environmental Audit. II. Application to Stream Network Design,
W86-00723 7A

Use of Watershed Characteristics to Select Control Streams for Estimating Effects of Metal Mining Wastes on Extensively Disturbed Streams,
W86-00725 5C

Flowing Water Resources,
W86-00791 2A

Distribution and Persistence of Aminocarb in Stream Water, Sediment and Fish After Application of Three Matacil Formulations,
W86-00811 5B

STRUCTURED MODELLING
Structured Modeling of the Anaerobic Digestion of Biomass Particulates,
W86-00848 5D

SULFATES
Model of Sulphate Concentration in a Small Stream in the Harp Lake Catchment, Ontario,
W86-00629 5B

Sulfate Determination in Industrial Wastewater by Liquid Chromatography with Postcolumn Solid-Phase Reaction Detection,
W86-00819 5A

SULFIDES
Oxidation of Sulfide and Thiosulfate and Storage of Sulfur Granules in Thiothrix from Activated Sludge,
W86-00745 5D

Kinetic Studies of the Microbiological Conversion of Sulphate to Hydrogen Sulphide and Their Relevance to Sulphide Generation Within Sewers,
W86-00746 5D

SULFITES
Effect of Sulfite Dechlorination on the Accumulation of Waterborne Lead by Rainbow Trout (Salmo gairdneri),
W86-00615 5A

SULFUR
Oxidation of Sulfide and Thiosulfate and Storage of Sulfur Granules in Thiothrix from Activated Sludge,
W86-00745 5D

SULFUR BACTERIA
Kinetic Studies of the Microbiological Conversion of Sulphate to Hydrogen Sulphide and Their Relevance to Sulphide Generation Within Sewers,
W86-00746 5D

SULFUR DIOXIDE
Effect of Flooding of Soil on Growth and Subsequent Responses of Taxodium distichum Seedlings to SO2,
W86-00861 5C

SURGES
Simple Governing and Surging Simulation, Part One,
W86-00801 8B

SUSPENDED PARTICULATES
Bacterial Adsorption and Suspended Particles in Urban Stormwater,
W86-00842 5B

SUSPENDED SEDIMENTS
Statistical Determination of the Optimal Sample Size of Secondary Effluent BOD5 and SS,
W86-00683 5A

Chemical Composition of Highway Drainage Waters; II. Chemical Associations of Metals in the Suspended Sediment,
W86-00709 5B

SUSQUEHANNA RIVER
Additions to Ichthyofauna of the Susquehanna River with a Checklist of Fishes of the Susquehanna River Drainage below Conowingo Dam,
W86-00635 2H

SWALE
Environmental Impact of Paper Mill Waste Discharges to the Swale,
W86-00863 5C

SWEDEN
Allium Test on River Water from Braan and Saxan Before and After Closure of a Chemical Factory,
W86-00667 5A

SWIRL CONCENTRATORS
Use of a Swirl Concentrator for Combined Sewer Overflow Management,
W86-00844 5D

SWITZERLAND
Oligochaete Communities of the Sublittoral as Indicators of Lake Geneva Eutrophication,
W86-00624 5A

TACOMA
Removing VOC from Groundwater; Pilot, Scale-up, and Operating Experience,
W86-00816 5F

TAILWATERS
Invertebrate Colonization Rates in the Tailwater of a Kentucky Flood-Control Reservoir,
W86-00618 6G

TANTARE LAKE
Zinc Deposition in Acid Lakes: The Role of Diffusion,
W86-00689 5B

TEMPERATURE EFFECTS
Effect of Temperature on Oxygen Transfer Rate in Wastewater Treatment,
W86-00658 5D

Evaluation of Temperature Effects on Trickling Filter Plant Performance,
W86-00737 5D

TENNESSEE
Phosphorus Spiralling in a Woodland Stream: Seasonal Variations,
W86-00830 2H

TENNESSEE RIVER
Checklist of Phytoplankton (Exclusive of Diatoms) in Kentucky Reservoir,
W86-00631 2H

TERRAIN ANALYSIS
Bottomland Vegetation Distribution Along Passage Creek, Virginia, In Relation to Fluvial Landforms,
W86-00826 2H

TESTING PROCEDURES
Method for Aquatic Multiple Species Toxicant Testing: Acute Toxicity of 10 Chemicals to 5 Vertebrates and 2 Invertebrates,
W86-00654 5A

TETRAHYMENA
Testing for the Toxicity of Chemicals with Tetrahymena pyriformis,
W86-00711 5A

THAMES RIVER
Bulk Supply Scheme of the Mid Southern and North Surrey Water Companies,
W86-00835 3B

THERMAL POLLUTION
Replacement of Stenonema spp. by Caenis diminuta Walker as the Numerical Dominant in the Mayfly Assemblage of a Thermally-Stressed Stream,
W86-00617 5C

THERMOPHILIC DIGESTION
Thermophilic Anaerobic Contact Digestion of Palm Oil Mill Effluent,
W86-00744 5D

THIOSULFATES
Oxidation of Sulfide and Thiosulfate and Storage of Sulfur Granules in Thiothrix from Activated Sludge,
W86-00745 5D

THIOTHRIX
Oxidation of Sulfide and Thiosulfate and Storage of Sulfur Granules in Thiothrix from Activated Sludge,
W86-00745 5D

THIRAM
Example of Interaction Between Environmental Pollutants: Modification of Thiram Toxicity to Freshwater Organisms by Nitrites or Nitrates in Relation to Nitrosamine Synthesis,
W86-00877 5C

THORIUM
Radiological Impact of Mining in a Th-Rich Norwegian Area,
W86-00823 5B

TIDAL MARSHES
Influence of Salinity on Scirpus americanus Tidal Marshes in the St. Lawrence River Estuary, Quebec,
W86-00902 2L

TILAPIA
Methyl Parathion (O-O-Dimethyl O-4-Nitrophenyl Thiophosphate) Effects on Whole-Body and Tissue Respiration in the Teleost, Tilapia mossambica (Peters),
W86-00878 5C

TIN COMPOUNDS
Fate and Effects of Organotin Compounds,
W86-00665 5B

TORONTO
Monitoring Urban Waterways to Reduce Flood Damage and Ensure Public Safety,
W86-00687 4A

TOXICITY
Effect of pH on Toxicity of Sodium Pentachlorophenate to Fry of Common Carp in Softwater,
W86-00626 5C

Effects of Available Dietary Carbohydrate and Water Temperature on the Chronic Toxicity of Waterborne Copper to Rainbow Trout (Salmo gairdneri),
W86-00630 5C

Method for Aquatic Multiple Species Toxicant Testing: Acute Toxicity of 10 Chemicals to 5 Vertebrates and 2 Invertebrates,
W86-00654 5A

Metabolism of Aldrin by the Freshwater Planarian Phagocata gracilis,
W86-00693 5C

Toxicity and Accumulation of Copper and Cadmium in the Alga Scenedesmus obliquus LH,
W86-00697 5C

Testing for the Toxicity of Chemicals with Tetrahymena pyriformis,
W86-00711 5A

Nitrite Exposure and Respiration Rates in Fathead Minnows,
W86-00729 5C

Acute and Chronic Toxicity of Technical Picloram (4-amino-3,5,6-trichloropicolinic acid) to Daphnia magna Straus,
W86-00731 5C

Percent Mortalities and LC50 Values for Selected Microcrustaceans Exposed to Treflan, Cutrine-plus, and MSMA Herbicides,
W86-00732 5C

Quantitative Structure-Toxicity Relationships with Osmotically Stressed Artemia salina Nauplii,
W86-00864 5C

Short-Term Test for Predicting the Potential of Xenobiotics to Impair Reproductive Success in Fish,
W86-00874 5A

Joint Toxicity of Mixtures of Groups of Organic Aquatic Pollutants to the Guppy (Poecilia reticulata),
W86-00876 5C

Example of Interaction Between Environmental Pollutants: Modification of Thiram Toxicity to Freshwater Organisms by Nitrites or Nitrates in Relation to Nitrosamine Synthesis,
W86-00877 5C

Methyl Parathion (O-O-Dimethyl O-4-Nitrophenyl Thiophosphate) Effects on Whole-Body and Tissue Respiration in the Teleost, Tilapia mossambica (Peters),
W86-00878 5C

Effects of Some Divalent Metals on Cardiac and Branchial Ca2+-ATPase in Freshwater Fish Saccobranchus fossilis,
W86-00880 5C

Dichlorvos Intoxication in a Freshwater Prawn, Macrobrachium lamarrei (H. Milne Edwards),
W86-00882 5C

Copper Toxicity to Cyanobacteria and its Dependence on Extracellular Ligand Concentration and Degradation,
W86-00910 5B

TOXINS
Potentially Toxic Blue-Green Algae (Cyanobacteria) in Finnish Natural Waters,
W86-00674 5B

Destroying Pyrogens in Water,
W86-00870 5F

TRACE METALS
Chemical Composition of Highway Drainage Waters; I. Major Ions and Selected Trace Metals,
W86-00708 5B

Trace-Metal Concentrations in Sediments from Two Closed-Basin Lakes. Antarctica,
W86-00770 2H

Mathematical Model for Analysis of Sediment Core Data: Implications for Enrichment Factor Calculations and Trace-Metal Transport Mechanisms,
W86-00772 5B

TREES
Effect of Flooding of Soil on Growth and Subsequent Responses of Taxodium distichum Seedlings to SO2,
W86-00861 5C

TRICHLOROETHYLENE
Packed Tower Aeration Strips Trichloroethylene from Groundwater,
W86-00817 5F

TRICKLING FILTERS
Evaluation of Temperature Effects on Trickling Filter Plant Performance,
W86-00737 5D

Activated Biofilter Process for Wastewater Treatment,
W86-00871 5D

TRIFLURALIN
Percent Mortalities and LC50 Values for Selected Microcrustaceans Exposed to Treflan, Cutrine-plus, and MSMA Herbicides,
W86-00732 5C

TRIHALOMETHANES
City Implements Trihalomethane Control Program,
W86-00808 5F

TROUT
Effect of Sulfite Dechlorination on the Accumulation of Waterborne Lead by Rainbow Trout (Salmo gairdneri),
W86-00615 5A

Effects of Available Dietary Carbohydrate and Water Temperature on the Chronic Toxicity of Waterborne Copper to Rainbow Trout (Salmo gairdneri),
W86-00630 5C

Separating Starvation Losses from Other Early Feeding Fry Mortality in Steelhead Trout Salmo gairdneri, Chinook Salmon Oncorhynchus tshawytscha, and Lake Trout Salvelinus namaycush,
W86-00728 5C

Sublethal Effects of Simulated Pulp Mill Effluents on the Respiration and Energy Metabolism of Rainbow Trout (Salmo gairdneri),
W86-00881 5C

TUNNELS
What's Going on Under Chicago,
W86-00767 8A

TURBINES
Simple Governing and Surging Simulation, Part One,
W86-00801 8B

ULTRAVIOLET RADIATION
UV Inactivation of Pathogenic and Indicator Microorganisms,
W86-00774 5D

Destroying Pyrogens in Water,
W86-00870 5F

UNSATURATED FLOW
Solute Dispersion During Axisymmetric Three-Dimensional Unsaturated Water Flow,
W86-00700 2G

UPFLOW ANAEROBIC SLUDGE BLANKET PROCESS
Methanogenesis in an Upflow Anaerobic Sludge Blanket Reactor at pH 6 on an Acetate-Propionate Mixture,
W86-00776 5D

UPFLOW BLANKET FILTERS
Performance of an Upflow Anaerobic Reactor Combining a Sludge Blanket and a Filter Treating Sugar Waste,
W86-00889 5D

UPGRADING
Hydro-plant Upgrades Yield Reliable, Cost-effective Kilowatts,
W86-00804 8C

URANIUM MINES
Development of a New Process for Treating Uranium Mining Effluents,
W86-00759 5D

URBAN RUNOFF
Urban Runoff: Pollution Sources, Control, and Treatment,
W86-00781 5G

Bacterial Adsorption and Suspended Particles in Urban Stormwater,
W86-00842 5B

USSR
Dynamics of the Structure of the Ichthyocenosis of Lake Ubinskoye,
W86-00912 2H

UTAH
Water for Salt Lake City,
W86-00809 3B

UTILITIES
Assessment of Water Utility Information Systems and Their Use of Computers,
W86-00795 5F

Byzantine Art of Water Utility Ratemaking,
W86-00868 6C

VEGETATION
Bottomland Vegetation Distribution Along Passage Creek, Virginia, In Relation to Fluvial Landforms,
W86-00826 2H

VEGETATION

Hydrologic and Vegetational Changes Resulting from Underground Pumping at the Cypress Creek Well Field, Pasco County, Florida,
W86-00899 6G

VELOCITY
Effect of Velocity of Water Flow on Growth of Colonial Hydroids (Hydrozoa, Thecaphora),
W86-00722 2H

VENDACE
Iodine Content of the Tissues of the Vendace (Coregonus albula L.) in Correlation to the Iodine Content of the Ambient Water,
W86-00679 2H

VIBRATIONS
Modelling Vibration and Vortex Formation at Piedra del Aguila,
W86-00800 8B

VIRGINIA
Bottomland Vegetation Distribution Along Passage Creek, Virginia, In Relation to Fluvial Landforms,
W86-00826 2H

Superhydro,
W86-00883 8A

VIRUSES
Elimination of Viruses and Indicator Bacteria at Each Step of Treatment During Preparation of Drinking Water at Seven Water Treatment Plants,
W86-00775 5F

Viral Pollution of the Marine Environment,
W86-00851 5B

VOLATILE COMPOUNDS
Carbon Adsorption Isotherm Test for Volatile Organic Chemicals in Water,
W86-00845 5A

VOLATILE ORGANIC COMPOUNDS
Removing VOC from Groundwater; Pilot, Scale-up, and Operating Experience,
W86-00816 5F

VORTICES
Modelling Vibration and Vortex Formation at Piedra del Aguila,
W86-00800 8B

WALES
Flotation that Might Sink,
W86-00831 6E

WALKER BRANCH
Phosphorus Spiralling in a Woodland Stream: Seasonal Variations,
W86-00830 2H

WASHINGTON
Seasonal Precipitation Forecasting with a 6-7 Month Lead Time in the Pacific Northwest Using an Information Theoretic Model,
W86-00778 2B

Removing VOC from Groundwater; Pilot, Scale-up, and Operating Experience,
W86-00816 5F

WASHINGTON (DISTRICT OF COLUMBIA)
Time and Institutional Requirements,
W86-00796 6F

WASTEWATER
Anomalies Arising from Arbitrary Measures of the Strength of Sewage,
W86-00814 5D

WASTEWATER POLLUTION
Effects of Treated Sewage Effluent and Bay-Bottom Mud on Growth of Marine Phytoplankton,
W86-00616 5C

Effects of Sewage on Lake Champlain Wetland,
W86-00619 5C

WASTEWATER RENOVATION
Simulated Solute Movement in Wastewater-Ponded Soil,
W86-00699 5D

Total Effluent Treatment and Rinse Water Reclamation in a Semiconductor Device Manufacturing Facility,
W86-00758 5D

WASTEWATER TREATMENT
Effect of Temperature on Oxygen Transfer Rate in Wastewater Treatment,
W86-00658 5D

Binding of Cadmium, Copper, and Lead Ions by Modified Cellulosic Materials,
W86-00692 5D

Heavy Metal Concentrations in Municipal Wastewater Treatment Plant Sludge,
W86-00726 5B

Evaluation of Temperature Effects on Trickling Filter Plant Performance,
W86-00737 5D

Phosphorus Removal from Wastewater by the Crystallization Method,
W86-00741 5D

A-B Process: A Novel Two Stage Wastewater Treatment System,
W86-00750 5D

Application of Predenitrification Nitrification Technology for Trace Contaminant Control,
W86-00763 5D

Lumped-Parameter Modeling of Multicomponent Adsorption in the Treatment of Coal-Conversion Wastewater by GAC,
W86-00815 5D

Removal of Phosphate at Sewage Treatment Works and Implications on Phosphate Loadings into Lough Neagh,
W86-00834 5D

Survey Ties Needs to Water Quality,
W86-00838 5D

Biological Treatment of Landfill Leachates,
W86-00856 5D

Biological Removal of Phosphorus From Wastewater,
W86-00857 5D

Activated Biofilter Process for Wastewater Treatment,
W86-00871 5D

Anaerobic Pretreatment Reduces Mill Costs, Improves Effluent Quality,
W86-00890 5D

Ion Exchange Potentially Effective in Reducing Effluent from Bleach Plant,
W86-00892 5D

WASTEWATER TREATMENT FACILITIES
Innovative Water Management Plan Reduces Treatment Costs,
W86-00841 5D

WATER ALLOCATION
Simulation and Decisionmaking: The Platte River Basin in Nebraska,
W86-00790 6B

WATER ANALYSIS
Studies of Water Pollution of the River Cauvery - Physico-Chemical Characteristics,
W86-00657 5B

Allium Test on River Water from Braan and Saxan Before and After Closure of a Chemical Factory,
W86-00667 5A

Mutagenicity Assessment of Different Drinking Water Supplies before and after Treatments,
W86-00690 5A

Ion Chromatograph Provides Rapid Analysis of Air and Water,
W86-00768 5A

Extraction and Enrichment of Chlorinated Phenols from Surface Waters for the Determination by Capillary-GC/FTIR-Spectroscopy,
W86-00824 5A

Separation and Determination of Selenium(IV) in Environmental Water Samples by an Anion-Exchange Resin Modified with Bismuthiol-II and Diaminonaphthalene Fluorophotometry,
W86-00825 5A

WATER AUTHORITIES
Flotation that Might Sink,
W86-00831 6E

WATER CONVEYANCE
Assessment of Water Utility Information Systems and Their Use of Computers,
W86-00795 5F

Overcoming the Barriers,
W86-00798 6C

Water for Salt Lake City,
W86-00809 3B

WATER CURRENTS
Effect of Velocity of Water Flow on Growth of Colonial Hydroids (Hydrozoa, Thecaphora),
W86-00722 2H

WATER DISTRIBUTION
Time and Institutional Requirements,
W86-00796 6F

WATER HARVESTING
Length and Slope Effects on Runoff from Sodium Dispersed, Compacted Earth Microcatchments,
W86-00705 3B

WATER MANAGEMENT
Geographic Information Systems for Natural Resource Management,
W86-00649 7C

Re-Evaluating the Extent of Groundwater Contamination,
W86-00686 5G

Simulation and Decisionmaking: The Platte River Basin in Nebraska,
W86-00790 6B

WATER POLLUTION
Distribution of Heavy Metals in Water and Sediments of Selected Sites of Yamuna River (India); Environmental Monitoring of the Yamuna River - Part I,
W86-00685 5B

Mercury Distribution in a Polluted Marine Area. Concentrations of Methyl Mercury in Sediments and Some Marine Organisms,
W86-00707 5A

WATER POLLUTION CONTROL
Status of Nonpoint Source Pollution: Its Nature, Extent and Control,
W86-00779 5B

Urban Runoff: Pollution Sources, Control, and Treatment,
W86-00781 5G

Farmers' Attitudes Toward Nonpoint Pollution Control and Participation in Cost-Share Programs,
W86-00782 5G

Watershed Planning for Acid Mine Drainage Abatement,
W86-00787 4D

Alternative Approaches to Acid Rain Control,
W86-00867 6E

WATER POLLUTION EFFECTS
Effects of Sewage on Lake Champlain Wetland,
W86-00619 5C

Distribution of Aluminum in the Tissues of Three Fish Species,
W86-00621 5C

Influence of Oil Refinery Effluents on the Structure of Algal Communities,
W86-00623 5C

In Vitro Effect of Mercuric Chloride on Acid and Alkaline Phosphatase Activity of a Freshwater Prawn,
W86-00625 5C

Effect of pH on Toxicity of Sodium Pentachlorophenate to Fry of Common Carp in Softwater,
W86-00626 5C

Bacteriological Survey of Two Acid-Stressed Lakes in the Poconos before Limestone Application,
W86-00634 5C

Destruction of Water Resources - The Most Critical Ecological Crisis of East Asia,
W86-00666 4C

Growth Inhibition and Recovery in Mussels (Mytilus edulis) Exposed to Low Copper Concentrations,
W86-00668 5C

Long-Term Ecosystem Stress: The Effects of Years of Experimental Acidification on a Small Lake,
W86-00688 5C

Organochlorine Residues in Animals from Three Louisiana Watersheds in 1978 and 1979,
W86-00691 5B

Effects of Cadmium and Copper on Chemotaxis of Marine and Freshwater Ciliates,
W86-00696 5C

Use of Watershed Characteristics to Select Control Streams for Estimating Effects of Metal Mining Wastes on Extensively Disturbed Streams,
W86-00725 5C

Environmental and Economic Damage Caused by Sediment from Agricultural Nonpoint Sources,
W86-00784 5C

Gold-Mining Effects on Stream Hydrology and Water Quality, Circle Quadrangle, Alaska,
W86-00785 4C

Effect of Acid Rain on Soils,
W86-00858 5C

Environmental Impact of Paper Mill Waste Discharges to the Swale,
W86-00863 5C

Fish Physiology and Metal Pollution: Results and Experiences from Laboratory and Field Studies,
W86-00873 5C

Joint Toxicity of Mixtures of Groups of Organic Aquatic Pollutants to the Guppy (Poecilia reticulata),
W86-00876 5C

Sublethal Effects of Simulated Pulp Mill Effluents on the Respiration and Energy Metabolism of Rainbow Trout (Salmo gairdneri),
W86-00881 5C

WATER POLLUTION SOURCES
Pollution Loadings from Finnish Inland Fish-Farms: A Case Study,
W86-00680 5B

Quality of Runoff Water from Finnish Fuel Peat Mining Areas,
W86-00682 5B

Storm Water Runoff from Industrial Sites,
W86-00766 5B

WATER QUALITY
Automatic Water Quality Monitoring in Rivers Exposed to Injurious Activities,
W86-00671 5A

General Lake Water Quality Index,
W86-00673 2H

Impact of Hydraulic Works on Water Quality, Part Two,
W86-00802 6G

Relationships Between Surface Sediment Diatom Assemblages and Lakewater Characteristics in Adirondack Lakes,
W86-00829 2H

Innovative Water Quality-Based Permitting: A Policy Perspective,
W86-00839 5G

Microbiological Quality of Recreational Waters in the Pacific Northwest,
W86-00840 5B

WATER QUALITY CONTROL
Security of Groundwater Catchments Near Rivers; Charts to Determine the Variation in the Replenishment Flow (Surete des captages d'eau souterraine a proximite des rivieres; Abaques pour determiner l'evolution du debit de realimentation flow),
W86-00656 2F

Protecting Water Quality in the Midwest: Impact on Timber Harvesting Costs,
W86-00720 5D

Survey Ties Needs to Water Quality,
W86-00838 5D

WATER QUALITY MANAGEMENT
In-Lake Water Quality Management Plan for a Recreational Lake in Central Illinois,
W86-00794 5G

WATER QUALITY STANDARDS
Dissolved Oxygen Concentrations in Florida's Humic-Colored Waters and Water Quality Standard Implications,
W86-00901 5G

WATER RESOURCES
Flowing Water Resources,
W86-00791 2A

WATER RESOURCES DEVELOPMENT
Destruction of Water Resources - The Most Critical Ecological Crisis of East Asia,
W86-00666 4C

Salinity Issues and Water Development in the Green River Basin, Wyoming,
W86-00783 6E

Addressing Social and Environmental Issues in Water Resources Planning and Management,
W86-00793 6A

WATER RIGHTS
New Rules for National Forest Water,
W86-00716 6D

WATER SUPPLY
Factors Influencing the High Content of Brominated Trihalomethanes in Barcelona's Water Supply (Spain),
W86-00727 5B

WATER SUPPLY DEVELOPMENT
Re-Evaluating the Extent of Groundwater Contamination,
W86-00686 5G

Water for Salt Lake City,
W86-00809 3B

Bulk Supply Scheme of the Mid Southern and North Surrey Water Companies,
W86-00835 3B

WATER TABLE
Security of Groundwater Catchments Near Rivers; Charts to Determine the Variation in the Replenishment Flow (Surete des captages d'eau souterraine a proximite des rivieres; Abaques pour determiner l'evolution du debit de realimentation flow),
W86-00656 2F

WATER TEMPERATURE
Effects of Available Dietary Carbohydrate and Water Temperature on the Chronic Toxicity of Waterborne Copper to Rainbow Trout (Salmo gairdneri),
W86-00630 5C

WATER TREATMENT
Contaminant Degradation in Water,
W86-00660 5F

Mutagenicity Assessment of Different Drinking Water Supplies before and after Treatments,
W86-00690 5A

Potential Use of Enzymes for Removal of Aromatic Compounds from Water,
W86-00753 5F

Elimination of Viruses and Indicator Bacteria at Each Step of Treatment During Preparation of Drinking Water at Seven Water Treatment Plants,
W86-00775 5F

Assessment of Water Utility Information Systems and Their Use of Computers,
W86-00795 5F

Trends in Drinking Water Treatment The Shape of Things to Come,
W86-00805 5F

Utility Battles Iron and Manganese,
W86-00807 5F

City Implements Trihalomethane Control Program,
W86-00808 5F

Removing VOC from Groundwater; Pilot, Scale-up, and Operating Experience,
W86-00816 5F

Packed Tower Aeration Strips Trichloroethylene from Groundwater,
W86-00817 5F

Removal of Naturally Occurring Compounds by Coagulation and Sedimentation,
W86-00855 5F

Byzantine Art of Water Utility Ratemaking,
W86-00868 6C

Destroying Pyrogens in Water,
W86-00870 5F

WATERCRESS
Toxic Effects of Iron Ore Tailings and the Response of Watercress from Tailings at High Concentrations of Fe, Zn and Mn,
W86-00653 5C

WATERSHED
Modeling Hydroclimatic Processes in Large Watersheds,
W86-00647 2A

WATERSHED MANAGEMENT
Watershed Planning for Acid Mine Drainage Abatement,
W86-00787 4D

WATERSHEDS
Use of Watershed Characteristics to Select Control Streams for Estimating Effects of Metal Mining Wastes on Extensively Disturbed Streams,
W86-00725 5C

WEIRS
Proportional Weirs for Stormwater Pond Outlets,
W86-00887 8A

WELLS
Hydrologic and Vegetational Changes Resulting from Underground Pumping at the Cypress Creek Well Field, Pasco County, Florida,
W86-00899 6G

WET DEPOSITION
Wet and Dry Deposition Monitoring in Southeastern Michigan,
W86-00719 5A

WETLANDS
Effects of Sewage on Lake Champlain Wetland,
W86-00619 5C

Some Mire Systems in Japan,
W86-00904 2H

WHEAT
Effect of Drought on Metabolism and Partitioning of Carbon in Two Wheat Varieties Differing in Drought-Tolerance,
W86-00907 2I

Effects of Drought on Partitioning of Nitrogen in Two Wheat Varieties Differing in Drought-Tolerance,
W86-00908 2I

WHITE DEER LAKE
Bacteriological Survey of Two Acid-Stressed Lakes in the Poconos before Limestone Application,
W86-00634 5C

WIDAWKA
Influence of Development of the River Widawka on the Ephemeroptera Fauna (Influence des Amenagements de la Riviere Widawka sur la Faune des Ephemeropteres),
W86-00914 5C

WISCONSIN
Snowmelt Energy Budgets in Southern and East-Central Wisconsin,
W86-00648 2C

Primary/Secondary Sludge Recycled into Valuable Agricultural Fertilizer,
W86-00891 5E

WYOMING
Salinity Issues and Water Development in the Green River Basin, Wyoming,
W86-00783 6E

YAMUNA RIVER
Distribution of Heavy Metals in Water and Sediments of Selected Sites of Yamuna River (India); Environmental Monitoring of the Yamuna River - Part I,
W86-00685 5B

ZINC
Toxic Effects of Iron Ore Tailings and the Response of Watercress from Tailings at High Concentrations of Fe, Zn and Mn,
W86-00653 5C

Zinc Deposition in Acid Lakes: The Role of Diffusion,
W86-00689 5B

Mobility of Zinc, Cadmium, Copper, Lead, Iron and Arsenic in Ground Water as a Function of Redox Potential and pH,
W86-00706 5B

AUTHOR INDEX

ABER, J. D.
Factors Controlling Mass Loss and Nitrogen Dynamics of Plant Litter Decaying in Northern Streams,
W86-00637 2K

ACTON, D. F.
Effect of Groundwater on Soil Formation in a Morainal Landscape in Saskatchewan,
W86-00670 2F

ADIN, A.
Evaluation of Temperature Effects on Trickling Filter Plant Performance,
W86-00737 5D

AGUADO, E.
Snowmelt Energy Budgets in Southern and East-Central Wisconsin,
W86-00648 2C

AHAMMAD SAHIB, I. K.
Methyl Parathion (O-O-Dimethyl O-4-Nitrophenyl Thiophosphate) Effects on Whole-Body and Tissue Respiration in the Teleost, Tilapia mossambica (Peters),
W86-00878 5C

AHERN, J.
Salinity Issues and Water Development in the Green River Basin, Wyoming,
W86-00783 6E

AHLERT, R. C.
Biological Treatment of Landfill Leachates,
W86-00856 5D

AHMAD, S.
Thermophilic Anaerobic Contact Digestion of Palm Oil Mill Effluent,
W86-00744 5D

AJMAL, M.
Distribution of Heavy Metals in Water and Sediments of Selected Sites of Yamuna River (India); Environmental Monitoring of the Yamuna River - Part I,
W86-00685 5B

ALBERTS, J. J.
Influence of pH on the Binding Capacity and Conditional Stability Constants of Aluminum and Naturally-Occurring Organic Matter,
W86-00773 2K

ALBIGNAT, J. P.
Impact of Hydraulic Works on Water Quality, Part Two,
W86-00802 6G

ALLEMAN, J. E.
Elevated Nitrite Occurrence in Biological Wastewater Treatment Systems,
W86-00764 5D

ALLEN, E. D.
Limnology and Macrophyte Vegetation of a Deep, Clear Limestone Lake, Loch Borralie,
W86-00905 2H

ANDERSON, J. L.
Microarray Electrochemical Flow Detectors at High Applied Potentials and Liquid Chromatography with Electrochemical Detection of Carbamate Pesticides in River Water,
W86-00820 7B

ANDERSON, W. B.
Development of a New Process for Treating Uranium Mining Effluents,
W86-00759 5D

ANDREWS, R. C.
Development of a New Process for Treating Uranium Mining Effluents,
W86-00759 5D

ANTHONY, N. C.
Microbiological Quality of Recreational Waters in the Pacific Northwest,
W86-00840 5B

ARTEAGA, I.
Chemical-Physical Changes Associated With Environmental Gradients in the Oka River Basin,
W86-00916 2H

ARVIN, E.
Biological Removal of Phosphorus From Wastewater,
W86-00857 5D

ARVOLA, L.
Relations Between Phytoplankton and Environmental Factors in a Small, Spring-Meromictic Lake in Southern Finland,
W86-00672 2H

ASHLEY, W. M.
City Implements Trihalomethane Control Program,
W86-00808 5F

BALLANCE, R. C.
Drinking-water and Sanitation Projects: Criteria for Resource Allocation,
W86-00669 5F

BANSAL, S. K.
Effects of Some Divalent Metals on Cardiac and Branchial Ca2+-ATPase in Freshwater Fish Saccobranchus fossilis,
W86-00880 5C

BARCLAY, A. M.
Limnology and Macrophyte Vegetation of a Deep, Clear Limestone Lake, Loch Borralie,
W86-00905 2H

BARKER, R.
Destroying Pyrogens in Water,
W86-00870 5F

BARNESE, L. E.
Checklist of Phytoplankton (Exclusive of Diatoms) in Kentucky Reservoir,
W86-00631 2H

BARRELL, S. L.
Rain Estimation in Extratropical Cyclones Using GMS Imagery,
W86-00859 2B

BARRETT, G. W.
Effects of Municipal Sludge and Fertilizer on Heavy Metal Accumulation in Earthworms,
W86-00862 5C

BARTOLONI, K.
New Rules for National Forest Water,
W86-00716 6D

BATCHELOR, B.
Modification of a Metal Adsorption Model to Describe the Effect of pH,
W86-00847 5B

BAUMANN, E. R.
Evaluation of Temperature Effects on Trickling Filter Plant Performance,
W86-00737 5D

BEASLEY, D. B.
Using Simulation to Assess the Impacts of Conservation Tillage on Movement of Sediment and Phosphorus into Lake Erie,
W86-00650 4D

BECCARI, M.
Single Sludge Anoxic-Aerobic Systems for Biological Treatment of Coke Plant Wastewaters,
W86-00765 5D

BECK, E. A.
Factors Influencing Hydrocarbon Degradation in Three Freshwater Lakes,
W86-00909 5B

BECKER, L.
Simulation and Decisionmaking: The Platte River Basin in Nebraska,
W86-00790 6B

BEHAN, J. J.
Net Benefit Model for Recreation Planning at Drinking Water Reservoirs,
W86-00792 6G

BEITINGER, T. L.
Nitrite Exposure and Respiration Rates in Fathead Minnows,
W86-00729 5C

BELANGER, T. V.
Dissolved Oxygen Concentrations in Florida's Humic-Colored Waters and Water Quality Standard Implications,
W86-00901 5G

Use of Seepage Meters to Estimate Groundwater Nutrient Loading to Lakes,
W86-00788 7B

BENJES, H. H. JR.
Innovative Water Management Plan Reduces Treatment Costs,
W86-00841 5D

BERG, D. J.
Distribution of Aluminum in the Tissues of Three Fish Species,
W86-00621 5C

BERG, N. H.
Estimating Regional Snow Water Equivalent with a Simple Simulation Model,
W86-00789 2C

BERK, S. G.
Effects of Cadmium and Copper on Chemotaxis of Marine and Freshwater Ciliates,
W86-00696 5C

BERRY, N. S. M.
Large-Diameter Flexible Steel Pipes for the Transfer Works of the Kielder Water Scheme,
W86-00832 8G

BHASIN, M. K.
Effect of pH on Toxicity of Sodium Pentachlorophenate to Fry of Common Carp in Softwater,
W86-00626 5C

BILLEN, G.
Rate of Bacterial Mortality in Aquatic Environments,
W86-00777 2A

BILLINGS, H. J.
Hydraulic Fill Dam Made Earthquake Resistant,
W86-00888 8A

BJERKLIE, D. M.
Gold-Mining Effects on Heavy Metals in Streams, Circle Quadrangle, Alaska,
W86-00786 5C

Gold-Mining Effects on Stream Hydrology and Water Quality, Circle Quadrangle, Alaska,
W86-00785 4C

BLACK, J. J.
Evidence for Polynuclear Aromatic Hydrocarbons in the Diet of Bottom-Feeding Fish,
W86-00694 5B

BLACK, P.
Evidence for Polynuclear Aromatic Hydrocarbons in the Diet of Bottom-Feeding Fish,
W86-00694 5B

BODE, H.
Mixing and Detention Time Distribution in Activated Sludge Tanks,
W86-00747 5D

BOLAND, J. J.
Alternative Solutions,
W86-00799 6C

BOUCHARD, J. P.
Security of Groundwater Catchments Near Rivers; Charts to Determine the Variation in the Replenishment Flow (Surete des captages d'eau souterraine a proximite des rivieres; Abaques pour determiner l'evolution du debit de realimentation flow),
W86-00656 2F

BOWMAN, R. D.
Seasonal Cycles of Phytoplankton Populations and Total Chlorophyll of the Lower St. Johns River Estuary, Florida,
W86-00900 2L

BOWMAN, W. D.
Seasonal and Diurnal Water Relations Adjustments in Three Evergreen Chaparral Shrubs,
W86-00827 2I

BOYNTON, W. R.
Spatial and Temporal Coupling of Nutrient Inputs to Estuarine Primary Production: The Role of Particulate Transport and Decomposition,
W86-00642 2L

BRAAKENSIEK, H.
Phosphate Removal by Crystallization in a Fluidized Bed,
W86-00742 5D

BRAMLEY, E. A.
Application of Simple Moisture Accounting Models to Ungauged Catchments,
W86-00836 2E

BREWSTER, J. D.
Microarray Electrochemical Flow Detectors at High Applied Potentials and Liquid Chromatography with Electrochemical Detection of Carbamate Pesticides in River Water,
W86-00820 7B

BRISCOE, J.
Evaluating Pump Characteristics in Developing Countries,
W86-00884 8C

BROWN, K. L.
Distribution of gamma Exposure Rates In a Reactor Effluent Stream Flood Plain System,
W86-00821 5B

BRUNT, K.
Sulfate Determination in Industrial Wastewater by Liquid Chromatography with Postcolumn Solid-Phase Reaction Detection,
W86-00819 5A

BRUSCHIN, J.
Modelling Vibration and Vortex Formation at Piedra del Aguila,
W86-00800 8B

BRYERS, J. D.
Structured Modeling of the Anaerobic Digestion of Biomass Particulates,
W86-00848 5D

BUHR, H. O.
Equalization Control Strategy for Activated Sludge Process Control,
W86-00749 5D

BUISHAND, T. A.
Effects of Storage on the Composition of Main Components in Rainwater Samples,
W86-00717 2K

BURNS, T. A.
Distribution of Aluminum in the Tissues of Three Fish Species,
W86-00621 5C

BUTCHER, J. B.
Pollutant Runoff Models: Selection and Use in Decision Making,
W86-00780 5B

BYERS, W. D.
Removing VOC from Groundwater; Pilot, Scale-up, and Operating Experience,
W86-00816 5F

CADLE, S. H.
Wet and Dry Deposition Monitoring in Southeastern Michigan,
W86-00719 5A

CADY, R.
Simulation and Decisionmaking: The Platte River Basin in Nebraska,
W86-00790 6B

CARIGNAN, R.
Zinc Deposition in Acid Lakes: The Role of Diffusion,
W86-00689 5B

CARLILE, B. L.
Sewage Effluent Pumps,
W86-00803 5D

CARRABBA, M. M.
Remote Detection of Groundwater Contaminants Using Far-Ultraviolet Laser-Induced Fluorescence,
W86-00818 7B

CARTWRIGHT, P. S.
Total Effluent Treatment and Rinse Water Reclamation in a Semiconductor Device Manufacturing Facility,
W86-00758 5D

CATHCART, W. W.
Enclosed Vessel Composting Begins at Cape May County,
W86-00713 5E

CECH, J. S.
Determination of Kinetic Constants of Activated Sludge Microorganisms,
W86-00752 5D

CHANDRA, S. V.
Effects of Some Divalent Metals on Cardiac and Branchial Ca2+-ATPase in Freshwater Fish Saccobranchus fossilis,
W86-00880 5C

CHANG, A. C.
Monte-Carlo Simulation of Noninteracting Solute Transport in a Spatially Heterogeneous Soil,
W86-00702 2G

CHANG, J. C. H.
UV Inactivation of Pathogenic and Indicator Microorganisms,
W86-00774 5D

CHAPLIN, R. A.
Simple Governing and Surging Simulation, Part One,
W86-00801 8B

CHAPRA, S. C.
Modification of a Metal Adsorption Model to Describe the Effect of pH,
W86-00847 5B

CHARLES, D. F.
Relationships Between Surface Sediment Diatom Assemblages and Lakewater Characteristics in Adirondack Lakes,
W86-00829 2H

CHEAH, S. C.
Thermophilic Anaerobic Contact Digestion of Palm Oil Mill Effluent,
W86-00744 5D

CHENG, C. Y.
Chemical Study of the Shohola Creek Headwaters, Pike County, Pennsylvania,
W86-00636 5B

CHIKUMA, M.
Separation and Determination of Selenium(IV) in Environmental Water Samples by an Anion-Exchange Resin Modified with Bismuthiol-II and Diaminonaphthalene Fluorophotometry,
W86-00825 5A

CHORMANN, F. H. JR.
Trace-Metal Concentrations in Sediments from Two Closed-Basin Lakes. Antarctica,
W86-00770 2H

CHRISTENSEN, R. A.
Seasonal Precipitation Forecasting with a 6-7 Month Lead Time in the Pacific Northwest Using an Information Theoretic Model,
W86-00778 2B

CHUDOBA, J.
Determination of Kinetic Constants of Activated Sludge Microorganisms,
W86-00752 5D

CHUDYK, W. A.
Remote Detection of Groundwater Contaminants Using Far-Ultraviolet Laser-Induced Fluorescence,
W86-00818 7B

CLOTHIER, B. E.
Solute Dispersion During Axisymmetric Three-Dimensional Unsaturated Water Flow,
W86-00700 2G

COLE, J. J.
Response of a Detrital Foodweb to Eutrophication,
W86-00638 5C

COLEMAN, M. J.
Primary/Secondary Sludge Recycled into Valuable Agricultural Fertilizer,
W86-00891 5E

COOKE, S. D.
Salinity Issues and Water Development in the Green River Basin, Wyoming,
W86-00783 6E

COONEY, J. J.
Factors Influencing Hydrocarbon Degradation in Three Freshwater Lakes,
W86-00909 5B

CORBO, P.
Biological Treatment of Landfill Leachates,
W86-00856 5D

COTRIM, J. R.
Itaipu, South America's Grande Dame,
W86-00886 8A

COULON, D. P.
Organochlorine Residues in Animals from Three Louisiana Watersheds in 1978 and 1979,
W86-00691 5B

CRITES, R. W.
Land Application Systems For Municipal Sludge,
W86-00714 5E

D'ANGLEJAN, B.
Comparison of Several Methods for the Determination of Iron Hydroxides and Associated Orthophosphates in Estuarine Particulate Matter,
W86-00769 2L

DAKKI, M.
Abiotic and Hydrobiologic Characteristics of the Mediterranean Running Waters (Caracteristiques Abiotiques and Hydrobiologiques des Eaux Courantes Mediterraneennes),
W86-00919 2H

DALLING, M. D.
Effects of Drought on Partitioning of Nitrogen in Two Wheat Varieties Differing in Drought-Tolerance,
W86-00908 2I

DALLING, M. J.
Effect of Drought on Metabolism and Partitioning of Carbon in Two Wheat Varieties Differing in Drought-Tolerance,
W86-00907 2I

DAMACHI, N. A.
Assessment of Water Utility Information Systems and Their Use of Computers,
W86-00795 5F

DANILEVSKY, A.
Superhydro,
W86-00883 8A

DASCH, J. M.
Wet and Dry Deposition Monitoring in Southeastern Michigan,
W86-00719 5A

DASGUPTA, P. K.
Fluorimetric Determination of Trace Hydrogen Peroxide in Water with a Flow Injection System,
W86-00645 5A

DAVIS, F. W.
Historical Changes in Submerged Macrophyte Communities of Upper Chesapeake Bay,
W86-00828 2H

DAVIS, R.
Chemical Study of the Shohola Creek Headwaters, Pike County, Pennsylvania,
W86-00636 5B

DAVIS, V. O.
Percent Mortalities and LC50 Values for Selected Microcrustaceans Exposed to Treflan, Cutrine-plus, and MSMA Herbicides,
W86-00732 5C

DAVISON, W.
Mathematical Model for Analysis of Sediment Core Data: Implications for Enrichment Factor Calculations and Trace-Metal Transport Mechanisms,
W86-00772 5B

DAYAN, U.
Analysis of Precipitation Chemistry Data from Alaska,
W86-00659 2K

DE CARLO, E. H.
Removal of Arsenic from Geothermal Fluids by Adsorptive Bubble Flotation with Colloidal Ferric Hydroxide,
W86-00662 5D

DE GROSBOIS, E.
Model of Sulphate Concentration in a Small Stream in the Harp Lake Catchment, Ontario,
W86-00629 5B

DE KORTE, K.
Steady State Measurement of Oxygenation Capacity,
W86-00756 5D

DE LAUNE, R. D.
Nutrient Fluxes in Eutrophic Coastal Louisiana Freshwater Lake,
W86-00724 2H

DE LOS SANTOS, A.
Surface Soil Water Content Measurement Using Pulsed Nuclear Magnetic Resonance Techniques,
W86-00698 2G

DEANS, C. H.
Responses of Macrobenthos Colonizing Estuarine Sediments Contaminated with Drilling Mud Containing Diesel Oil,
W86-00730 5C

DELBEATO, R.
Rain Estimation in Extratropical Cyclones Using GMS Imagery,
W86-00859 2B

DEMORT, C.
Seasonal Cycles of Phytoplankton Populations and Total Chlorophyll of the Lower St. Johns River Estuary, Florida,
W86-00900 2L

DEMPSEY, B. A.
Removal of Naturally Occurring Compounds by Coagulation and Sedimentation,
W86-00855 5F

DERK, L. A.
Effects of Cadmium and Copper on Chemotaxis of Marine and Freshwater Ciliates,
W86-00696 5C

DESCHENES, J.
Influence of Salinity on Scirpus americanus Tidal Marshes in the St. Lawrence River Estuary, Quebec,
W86-00902 2L

DI PINTO, A. C.
Single Sludge Anoxic-Aerobic Systems for Biological Treatment of Coke Plant Wastewaters,
W86-00765 5D

DIA, A.
Abiotic and Hydrobiologic Characteristics of the Mediterranean Running Waters (Caracteristiques Abiotiques and Hydrobiologiques des Eaux Courantes Mediterraneennes),
W86-00919 2H

DICKSON, D. T.
Macrobenthic Invertebrates of a Perturbed Stream in Southern Nigeria,
W86-00652 5C

DIERBERG, F. E.
Dissolved Oxygen Concentrations in Florida's Humic-Colored Waters and Water Quality Standard Implications,
W86-00901 5G

DILLON, P. J.
Model of Sulphate Concentration in a Small Stream in the Harp Lake Catchment, Ontario,
W86-00629 5B

DINES, R. A.
Environmental Impact of Paper Mill Waste Discharges to the Swale,
W86-00863 5C

DIXON, D. G.
Effects of Available Dietary Carbohydrate and Water Temperature on the Chronic Toxicity of Waterborne Copper to Rainbow Trout (Salmo gairdneri),
W86-00630 5C

DOKIYA, Y.
Chemical Components in the Precipitation at Komoro and Tsukuba, Japan in 1983,
W86-00810 5B

DOLD, P. L.
Equalization Control Strategy for Activated Sludge Process Control,
W86-00749 5D

DOLFING, J.
Methanogenesis in an Upflow Anaerobic Sludge Blanket Reactor at pH 6 on an Acetate-Propionate Mixture,
W86-00776 5D

DONG, Y.
Effect of Temperature on Oxygen Transfer Rate in Wastewater Treatment,
W86-00658 5D

DORFMAN, M. H.
UV Inactivation of Pathogenic and Indicator Microorganisms,
W86-00774 5D

DOWD, P. F.
Organochlorine Residues in Animals from Three Louisiana Watersheds in 1978 and 1979,
W86-00691 5B

DOWNING, D.
Innovative Water Quality-Based Permitting: A Policy Perspective,
W86-00839 5G

DOYLE, C.
Radiocesium Levels in Irish Sea Fish and the Resulting Dose to the Population of the Irish Republic,
W86-00822 5B

DRAGUN, J.
Carbon Adsorption Isotherm Test for Volatile Organic Chemicals in Water,
W86-00845 5A

DRBAL, K.
Toxicity and Accumulation of Copper and Cadmium in the Alga Scenedesmus obliquus LH,
W86-00697 5C

DREW, W.
Kinetic Studies of the Microbiological Conversion of Sulphate to Hydrogen Sulphide and Their Relevance to Sulphide Generation Within Sewers,
W86-00746 5D

DUDA, A. M.
Environmental and Economic Damage Caused by Sediment from Agricultural Nonpoint Sources,
W86-00784 5C

DUMAIS, C. M.
UV Inactivation of Pathogenic and Indicator Microorganisms,
W86-00774 5D

DUTT, G. R.
Length and Slope Effects on Runoff from Sodium Dispersed, Compacted Earth Microcatchments,
W86-00705 3B

ECKENFELDER, W. W. JR.
Development of Pollutant Specific Models for Toxic Organic Compounds in the Activated Sludge Process,
W86-00754 5D

EDWARDS, K. L.
Alluvial Fans: Novel Flood Challenge,
W86-00885 2E

EILBERT, R. F.
Seasonal Precipitation Forecasting with a 6-7 Month Lead Time in the Pacific Northwest Using an Information Theoretic Model,
W86-00778 2B

ELLEFSON, P. V.
Protecting Water Quality in the Midwest: Impact on Timber Harvesting Costs,
W86-00720 5D

ELMALEH, S.
Influence of Macromixing on Organic Carbon Uptake and Solids Production by Aerobic Suspended Biomass,
W86-00748 5D

ELRICK, D. E.
Solute Dispersion During Axisymmetric Three-Dimensional Unsaturated Water Flow,
W86-00700 2G

ELWOOD, J. W.
Phosphorus Spiralling in a Woodland Stream: Seasonal Variations,
W86-00830 2H

ELZERMAN, A. W.
Acidification of Southern Appalachian Lakes,
W86-00663 5B

Influence of pH on the Binding Capacity and Conditional Stability Constants of Aluminum and Naturally-Occurring Organic Matter,
W86-00773 2K

ENDICOTT, D. D.
Lumped-Parameter Modeling of Multicomponent Adsorption in the Treatment of Coal-Conversion Wastewater by GAC,
W86-00815 5D

ENGEMOEN, M.
Developing an Effective Storm Drainage Maintenance Program,
W86-00806 4A

EVANS, R. L.
In-Lake Water Quality Management Plan for a Recreational Lake in Central Illinois,
W86-00794 5G

EVENSEN, W. E.
Water for Salt Lake City,
W86-00809 3B

EVETT, S. R.
Length and Slope Effects on Runoff from Sodium Dispersed, Compacted Earth Microcatchments,
W86-00705 3B

FARMER, A. M.
Aquatic Angiosperm Communities from Lochs on Rhum,
W86-00906 2H

FARMER, J. K.
Heavy Metal Concentrations in Municipal Wastewater Treatment Plant Sludge,
W86-00726 5B

FEDORAK, P. M.
Batch Anaerobic Methanogensis of Phenolic Coal Conversion Wastewater,
W86-00743 5D

FELTZ, R. E.
Effect of Aeration, Cadmium Concentration, and Solids Content on Acid Extraction of Cadmium from a Municipal Wastewater Sludge,
W86-00846 5D

FERARD, J. F.
Example of Interaction Between Environmental Pollutants: Modification of Thiram Toxicity to Freshwater Organisms by Nitrites or Nitrates in Relation to Nitrosamine Synthesis,
W86-00877 5C

FERGUSON, B. K.
Watershed Planning for Acid Mine Drainage Abatement,
W86-00787 4D

FERREN, L. A.
Phosphorus Spiralling in a Woodland Stream: Seasonal Variations,
W86-00830 2H

FIELD, R.
Urban Runoff: Pollution Sources, Control, and Treatment,
W86-00781 5G

FIESSINGER, F.
Potential Use of Enzymes for Removal of Aromatic Compounds from Water,
W86-00753 5F

FINDLAY, D. L.
Long-Term Ecosystem Stress: The Effects of Years of Experimental Acidification on a Small Lake,
W86-00688 5C

FISKESJO, G.
Allium Test on River Water from Braan and Saxan Before and After Closure of a Chemical Factory,
W86-00667 5A

FITCH, J. H. JR.
Ion Exchange Potentially Effective in Reducing Effluent from Bleach Plant,
W86-00892 5D

FOELLMI, S. N.
Utility Battles Iron and Manganese,
W86-00807 5F

FORSYTH, F. M.
Large-Diameter Flexible Steel Pipes for the Transfer Works of the Kielder Water Scheme,
W86-00832 8G

FOSTER, G. D.
Quantitative Structure-Toxicity Relationships with Osmotically Stressed Artemia salina Nauplii,
W86-00864 5C

FRENCH, R. H.
Lake Modeling: State of the Art,
W86-00850 2H

FRISK, T.
Natural Occurrence of Pike-Perch (Stizostedion lucioperca (L.)) and Success of Introductions in Relation to Water Quality and Lake Area in Finland,
W86-00678 2H

Statistical Model for Conversion of Absorbance Measurements with Significant Iron Interference into Organic Carbon in a Polyhumic Lake,
W86-00676 5A

FUKASE, T.
Role of an Anaerobic Stage on Biological Phosphorus Removal,
W86-00738 5D

FULTON, G. P.
Trends in Drinking Water Treatment The Shape of Things to Come,
W86-00805 5F

FUWA, K.
Occurrence of Chlorinated Polynuclear Aromatic Hydrocarbons in Tap Water,
W86-00895 5B

GABBANI, G.
Seismic Microactivity and Water Level Variation in Industrial Area near Florence (Italy),
W86-00632 2F

GABIG, J.
Simulation and Decisionmaking: The Platte River Basin in Nebraska,
W86-00790 6B

GALLOWAY, J. N.
Analysis of Precipitation Chemistry Data from Alaska,
W86-00659 2K

GANCZARCZYK, J. J.
Dynamics of Nitrification in a Biological Fluidized Bed Reactor,
W86-00760 5D

GANNON, J. J.
Bacterial Adsorption and Suspended Particles in Urban Stormwater,
W86-00842 5B

GARVER, S. R.
Heavy Metal Concentrations in Municipal Wastewater Treatment Plant Sludge,
W86-00726 5B

GAUR, J. P.
Influence of Oil Refinery Effluents on the Structure of Algal Communities,
W86-00623 5C

GAVLE, D. R.
Storm Water Runoff from Industrial Sites,
W86-00766 5B

GERBER, A.
Influence of Extended Anaerobic Retention Time on the Performance of Phoredox Nutrient Removal Plants,
W86-00739 5D

GERSICH, F. M.
Acute and Chronic Toxicity of Technical Picloram (4-amino-3,5,6-trichloropicolinic acid) to Daphnia magna Straus,
W86-00731 5C

GILBERT, J. B.
Overcoming the Barriers,
W86-00798 6C

GILLEY, J.
Simulation and Decisionmaking: The Platte River Basin in Nebraska,
W86-00790 6B

GILLILAND, M. W.
Simulation and Decisionmaking: The Platte River Basin in Nebraska,
W86-00790 6B

GIMINGHAM, C. H.
Some Mire Systems in Japan,
W86-00904 2H

GIRALDEZ, J. V.
Monte-Carlo Simulation of Noninteracting Solute Transport in a Spatially Heterogeneous Soil,
W86-00702 2G

GIUDICELLI, J.
Abiotic and Hydrobiologic Characteristics of the Mediterranean Running Waters (Caracteristiques Abiotiques and Hydrobiologiques des Eaux Courantes Mediterraneennes),
W86-00919 2H

GLADDEN, J. B.
Distribution of gamma Exposure Rates In a Reactor Effluent Stream Flood Plain System,
W86-00821 5B

GODSHALK, G. L.
Accumulation of Sediment Organic Matter in a Hardwater Lake with Reference to Lake Ontogeny,
W86-00643 2J

GONZALEZ, G.
Patterns of Macroinvertebrate Distribution in the Llobregat River Basin (NE Spain),
W86-00917 2H

GOODRICH, D. L.
Step-Drawdown and Constant-Rate Pumping Tests,
W86-00712 2F

GOYAL, S. M.
Viral Pollution of the Marine Environment,
W86-00851 5B

GRAS, R.
Impact of Hydraulic Works on Water Quality, Part Two,
W86-00802 6G

GRASMICK, A.
Influence of Macromixing on Organic Carbon Uptake and Solids Production by Aerobic Suspended Biomass,
W86-00748 5D

GRAU, P.
Determination of Kinetic Constants of Activated Sludge Microorganisms,
W86-00752 5D

GRAVES, J. B.
Organochlorine Residues in Animals from Three Louisiana Watersheds in 1978 and 1979,
W86-00691 5B

GRAY, A. V.
Removal of Phosphate at Sewage Treatment Works and Implications on Phosphate Loadings into Lough Neagh,
W86-00834 5D

GRAY, N. F.
Environmental Protection in the Republic of Ireland,
W86-00813 5G

GREENHALGH, R.
Sorptive Capacity of an Aquatic Macrophyte for the Pesticide Aminocarb,
W86-00812 5A

GROSS, M.
Net Benefit Model for Recreation Planning at Drinking Water Reservoirs,
W86-00792 6G

GROSS, R. L.
Packed Tower Aeration Strips Trichloroethylene from Groundwater,
W86-00817 5F

GRUENDLING, G. K.
Effects of Sewage on Lake Champlain Wetland,
W86-00619 5C

GUIOT, S. R.
Performance of an Upflow Anaerobic Reactor Combining a Sludge Blanket and a Filter Treating Sugar Waste,
W86-00889 5D

GUNDERSON, J. H.
Effects of Cadmium and Copper on Chemotaxis of Marine and Freshwater Ciliates,
W86-00696 5C

GUNN, R. A.
Drinking-water and Sanitation Projects: Criteria for Resource Allocation,
W86-00669 5F

HABETS, L. H. A.
Anaerobic Pretreatment Reduces Mill Costs, Improves Effluent Quality,
W86-00890 5D

HALL, M. E.
Simulated Solute Movement in Wastewater-Ponded Soil,
W86-00699 5D

Solute Discharge During Steady Water Drainage from a Sand Tank,
W86-00701 2G

HARDWICK-WITMAN, M. N.
Biological Consequences of Ice Rafting in a New England Salt Marsh Community,
W86-00627 2L

HARREMOES, P.
Removal of Soluble Substrates in Fixed Films,
W86-00734 5D

HARRISON, R. M.
Chemical Composition of Highway Drainage Waters; I. Major Ions and Selected Trace Metals,
W86-00708 5B

Chemical Composition of Highway Drainage Waters; II. Chemical Associations of Metals in the Suspended Sediment,
W86-00709 5B

Chemical Composition of Highway Drainage Waters; III. Runoff Water Metal Speciation Characteristics,
W86-00710 5B

HART, M. J.'T
Effects of Storage on the Composition of Main Components in Rainwater Samples,
W86-00717 2K

HASIT, Y.
Sludge Management: A Research Update,
W86-00715 5E

HASZPRA, L.
Density of Precipitation Chemistry Networks,
W86-00684 7A

HAUX, C.
Fish Physiology and Metal Pollution: Results and Experiences from Laboratory and Field Studies,
W86-00873 5C

HAWKINS, R. M.
Percent Mortalities and LC50 Values for Selected Microcrustaceans Exposed to Treflan, Cutrine-plus, and MSMA Herbicides,
W86-00732 5C

HEINKING, G.
Use of a Swirl Concentrator for Combined Sewer Overflow Management,
W86-00844 5D

HERLONG, D. D.
Benthos-Plankton Relationship Upstream and Downstream of a Blackwater Impoundment,
W86-00620 6G

HERMANN, R.
Mobility of Zinc, Cadmium, Copper, Lead, Iron and Arsenic in Ground Water as a Function of Redox Potential and pH,
W86-00706 5B

HERMANOWICZ, S. W.
Dynamics of Nitrification in a Biological Fluidized Bed Reactor,
W86-00760 5D

HERMENS, J.
Joint Toxicity of Mixtures of Groups of Organic Aquatic Pollutants to the Guppy (Poecilia reticulata),
W86-00876 5C

HERRICKS, E. E.
Environmental Audit. II. Application to Stream Network Design,
W86-00723 7A

HILTON, J.
Mathematical Model for Analysis of Sediment Core Data: Implications for Enrichment Factor Calculations and Trace-Metal Transport Mechanisms,
W86-00772 5B

HILTON, J. W.
Effects of Available Dietary Carbohydrate and Water Temperature on the Chronic Toxicity of Waterborne Copper to Rainbow Trout (Salmo gairdneri),
W86-00630 5C

HIRAOKA, M.
Flexible Modelling of the Activated Sludge System - Theoretical and Practical Aspects,
W86-00751 5D

HITZHUSEN, F.
Economics of Erosion Control in a Subtropical Watershed: A Dominican Case,
W86-00894 2J

HOBBIE, J. E.
Response of a Detrital Foodweb to Eutrophication,
W86-00638 5C

HODSON, P. V.
Effect of Sulfite Dechlorination on the Accumulation of Waterborne Lead by Rainbow Trout (Salmo gairdneri),
W86-00615 5A

HOLCOMBE, G. W.
Method for Aquatic Multiple Species Toxicant Testing: Acute Toxicity of 10 Chemicals to 5 Vertebrates and 2 Invertebrates,
W86-00654 5A

HOLDER, G. A.
Kinetic Studies of the Microbiological Conversion of Sulphate to Hydrogen Sulphide and Their Relevance to Sulphide Generation Within Sewers,
W86-00746 5D

HOPKIN, S. P.
Heavy Metal in Isopods from the Supra-Littoral Zone on the Southern Shore of the Severn Estuary, UK,
W86-00865 5B

HOPKINS, D. L.
Acute and Chronic Toxicity of Technical Picloram (4-amino-3,5,6-trichloropicolinic acid) to Daphnia magna Straus,
W86-00731 5C

HOUSE, E.
Monitoring Urban Waterways to Reduce Flood Damage and Ensure Public Safety,
W86-00687 4A

HRUDEY, S. E.
Batch Anaerobic Methanogensis of Phenolic Coal Conversion Wastewater,
W86-00743 5D

HUCK, P. M.
Development of a New Process for Treating Uranium Mining Effluents,
W86-00759 5D

HUGGINS, L. F.
Using Simulation to Assess the Impacts of Conservation Tillage on Movement of Sediment and Phosphorus into Lake Erie,
W86-00650 4D

HUGHES, R. M.
Use of Watershed Characteristics to Select Control Streams for Estimating Effects of Metal Mining Wastes on Extensively Disturbed Streams,
W86-00725 5C

HULSHOFF POL, L. W.
Methanogenesis in an Upflow Anaerobic Sludge Blanket Reactor at pH 6 on an Acetate-Propionate Mixture,
W86-00776 5D

HUNG, Y.-T.
Effect of Temperature on Oxygen Transfer Rate in Wastewater Treatment,
W86-00658 5D

HUPP, C. R.
Bottomland Vegetation Distribution Along Passage Creek, Virginia, In Relation to Fluvial Landforms,
W86-00826 2H

HWANG, H.
Fluorimetric Determination of Trace Hydrogen Peroxide in Water with a Flow Injection System,
W86-00645 5A

IBRAHIM, A.
Thermophilic Anaerobic Contact Digestion of Palm Oil Mill Effluent,
W86-00744 5D

IL'INSKII, N. B.
Seepage-Limitation Optimization of the Shape of An Irrigation Channel by the Inverse Boundary-Value Problem Method,
W86-00869 3F

IMADA, N.
Effects of Treated Sewage Effluent and Bay-Bottom Mud on Growth of Marine Phytoplankton,
W86-00616 5C

ISHIKAWA, M.
Kinetic Analysis of BOD and Nitrogen Removal in an Oxidation Ditch,
W86-00755 5D

ISSAR, A.
Fossil Water under the Sinai-Negev Peninsula,
W86-00911 2F

ITOH, K.
Separation and Determination of Selenium(IV) in Environmental Water Samples by an Anion-Exchange Resin Modified with Bismuthiol-II and Diaminonaphthalene Fluorophotometry,
W86-00825 5A

JANA, B. B.
Distribution Pattern of Denitrifying Bacteria in Fish Ponds of Differing Farming Managements,
W86-00622 2H

JANSEN, J. LA C.
Removal of Soluble Substrates in Fixed Films,
W86-00734 5D

JARDIM, W. F.
Copper Toxicity to Cyanobacteria and its Dependence on Extracellular Ligand Concentration and Degradation,
W86-00910 5B

JASPERSON, W. H.
Influences of Snow Cover and Soil Moisture on Monthly Air Temperature,
W86-00860 2A

JAYAL, N. D.
Destruction of Water Resources - The Most Critical Ecological Crisis of East Asia,
W86-00666 4C

JAZDZEWSKA, T.
Influence of Development of the River Widawka on the Ephemeroptera Fauna (Influence des Amenagements de la Riviere Widawka sur la Faune des Ephemeropteres),
W86-00914 5C

JOKO, I.
Phosphorus Removal from Wastewater by the Crystallization Method,
W86-00741 5D

JORDEN, C.
Factors Affecting Leaching of Nutrients from an Intensively Managed Grassland in County Antrim, Northern Ireland,
W86-00903 5B

JOUANY, J. M.
Example of Interaction Between Environmental Pollutants: Modification of Thiram Toxicity to Freshwater Organisms by Nitrites or Nitrates in Relation to Nitrosamine Synthesis,
W86-00877 5C

KALINOWSKI, T. W.
Carbon Adsorption Isotherm Test for Volatile Organic Chemicals in Water,
W86-00845 5A

KASIMOV, A. R.
Seepage-Limitation Optimization of the Shape of An Irrigation Channel by the Inverse Boundary-Value Problem Method,
W86-00869 3F

KATHPAL, T. S.
Persistence of Aldrin in Flooded Soil under the Cover of Rice,
W86-00875 5B

KATSURAGI, Y.
Chemical Components in the Precipitation at Komoro and Tsukuba, Japan in 1983,
W86-00810 5B

KATTELMANN, R. C.
Estimating Regional Snow Water Equivalent with a Simple Simulation Model,
W86-00789 2C

KAWAKAMI, T.
Location of Phosphorus in Activated Sludge and Function of Intracellular Polyphosphates in Biological Phosphorus Removal Process,
W86-00740 5D

KEENE, W. C.
Analysis of Precipitation Chemistry Data from Alaska,
W86-00659 2K

KEMP, W. M.
Spatial and Temporal Coupling of Nutrient Inputs to Estuarine Primary Production: The Role of Particulate Transport and Decomposition,
W86-00642 2L

KENNY, J. E.
Remote Detection of Groundwater Contaminants Using Far-Ultraviolet Laser-Induced Fluorescence,
W86-00818 7B

KERNS, W. R.
Farmers' Attitudes Toward Nonpoint Pollution Control and Participation in Cost-Share Programs,
W86-00782 5G

KERSTER, H. W.
Environmental Audit. II. Application to Stream Network Design,
W86-00723 7A

KETO, J.
Potentially Toxic Blue-Green Algae (Cyanobacteria) in Finnish Natural Waters,
W86-00674 5B

KEUP, L. E.
Flowing Water Resources,
W86-00791 2A

KHAN, M. A.
Distribution of Heavy Metals in Water and Sediments of Selected Sites of Yamuna River (India); Environmental Monitoring of the Yamuna River - Part I,
W86-00685 5B

KHANGAROT, B. S.
Effect of pH on Toxicity of Sodium Pentachlorophenate to Fry of Common Carp in Softwater,
W86-00626 5C

KIM, H. T.
PCBs in Striped Bass Collected from the Hudson River, New York, During Fall, 1981,
W86-00695 5C

KIM, J. S.
PCBs in Striped Bass Collected from the Hudson River, New York, During Fall, 1981,
W86-00695 5C

KING, J. M.
Checklist of Phytoplankton (Exclusive of Diatoms) in Kentucky Reservoir,
W86-00631 2H

KLAR, L. R. JR.
Net Benefit Model for Recreation Planning at Drinking Water Reservoirs,
W86-00792 6G

KLEIN, D.
Example of Interaction Between Environmental Pollutants: Modification of Thiram Toxicity to Freshwater Organisms by Nitrites or Nitrates in Relation to Nitrosamine Synthesis,
W86-00877 5C

KLEMETSON, S. L.
Factors Affecting Stream Transport of Combined Sewer Overflow Sediments,
W86-00843 5B

KLOCK, G. O.
Modeling the Cumulative Effects of Forest Practices on Downstream Aquatic Ecosystems,
W86-00651 6G

KNELISSEN, J. H.
Anaerobic Pretreatment Reduces Mill Costs, Improves Effluent Quality,
W86-00890 5D

KOBAYASHI, K.
Effects of Treated Sewage Effluent and Bay-Bottom Mud on Growth of Marine Phytoplankton,
W86-00516 5C

KOBAYASHI, S.
Chemical Components in the Precipitation at Komoro and Tsukuba, Japan in 1983,
W86-00810 5B

KOHONEN, T.
Automatic Water Quality Monitoring in Rivers Exposed to Injurious Activities,
W86-00671 5A

KOJIMA, H.
Studies on the Sequence of 2,6-Diisopropylnaphthalene Metabolite Formation Using Carp Hepatocyte,
W86-00879 5C

KONONEN, K.
Potentially Toxic Blue-Green Algae (Cyanobacteria) in Finnish Natural Waters,
W86-00674 5B

KOWNACKI, A.
Effect of Droughts on the Invertebrate Communities of High Mountain Streams,
W86-00915 2H

KOZLOWSKI, T. T.
Effect of Flooding of Soil on Growth and Subsequent Responses of Taxodium distichum Seedlings to SO2,
W86-00861 5C

KRAMER, R. A.
Farmers' Attitudes Toward Nonpoint Pollution Control and Participation in Cost-Share Programs,
W86-00782 5G

KRAUCH, H. W.
Itaipu, South America's Grande Dame,
W86-00886 8A

KREMPEL, R. E.
Developing an Effective Storm Drainage Maintenance Program,
W86-00806 4A

KRUSE, E. A.
Effects of Municipal Sludge and Fertilizer on Heavy Metal Accumulation in Earthworms,
W86-00862 5C

KUMAR, H. R.
Influence of Oil Refinery Effluents on the Structure of Algal Communities,
W86-00623 5C

KUMAR, S.
Eulerian Model for Scavenging of Pollutants by Raindrops,
W86-00718 5B

KUMSAH, C. A.
Binding of Cadmium, Copper, and Lead Ions by Modified Cellulosic Materials,
W86-00692 5D

KUSHWAHA, K. S.
Persistence of Aldrin in Flooded Soil under the Cover of Rice,
W86-00875 5B

KUUSISTO, E.
Filling in the Gap Between Hydrology and Hydrobiology - the Viewpoint of a Hydrologist,
W86-00675 2H

LAHTI, E.
Iodine Content of the Tissues of the Vendace (Coregonus albula L.) in Correlation to the Iodine Content of the Ambient Water,
W86-00679 2H

LAMBERS, H.
Effect of Drought on Metabolism and Partitioning of Carbon in Two Wheat Varieties Differing in Drought-Tolerance,
W86-00907 2I

Effects of Drought on Partitioning of Nitrogen in Two Wheat Varieties Differing in Drought-Tolerance,
W86-00908 2I

LANDINE, R. C.
Activated Biofilter Process for Wastewater Treatment,
W86-00871 5D

LANDNER, L.
Short-Term Test for Predicting the Potential of Xenobiotics to Impair Reproductive Success in Fish,
W86-00874 5A

LANG, C.
Oligochaete Communities of the Sublittoral as Indicators of Lake Geneva Eutrophication,
W86-00624 5A

LAPERRIERE, J. D.
Gold-Mining Effects on Heavy Metals in Streams, Circle Quadrangle, Alaska,
W86-00786 5C

Gold-Mining Effects on Stream Hydrology and Water Quality, Circle Quadrangle, Alaska,
W86-00785 4C

LARKIN, P. A.
Evaluation by Field Experiments of the McLay Model of Stream Drift,
W86-00628 2H

LARSSON, A.
Fish Physiology and Metal Pollution: Results and Experiences from Laboratory and Field Studies,
W86-00873 5C

LAUGHLIN, R. B.
Fate and Effects of Organotin Compounds,
W86-00665 5B

LEEUWANGH, P.
Joint Toxicity of Mixtures of Groups of Organic Aquatic Pollutants to the Guppy (Poecilia reticulata),
W86-00876 5C

LEHR, J. H.
Re-Evaluating the Extent of Groundwater Contamination,
W86-00686 5G

LEHTONEN, H.
Natural Occurrence of Pike-Perch (Stizostedion lucioperca (L.)) and Success of Introductions in Relation to Water Quality and Lake Area in Finland,
W86-00678 2H

LEICHTFRIED, M.
Organic Matter in Gravel Streams (Project RITRODAT-LUNZ),
W86-00913 2H

LENCASTRE, A.
State of the Art on the Dimensioning of Spillways for Dams, Appendix: Crossed Jet Spillways (Etat des connaissances sur le dimensionnement des evacuateurs de crue des barrages, Annexe: Evacuateurs a jets croises),
W86-00655 8A

LETTINGA, G.
Methanogenesis in an Upflow Anaerobic Sludge Blanket Reactor at pH 6 on an Acetate-Propionate Mixture,
W86-00776 5D

LINDEN, O.
Fate and Effects of Organotin Compounds,
W86-00665 5B

LINDGREN, S.
Sublethal Effects of Simulated Pulp Mill Effluents on the Respiration and Energy Metabolism of Rainbow Trout (Salmo gairdneri),
W86-00881 5C

LINDQVIST, O.
Iodine Content of the Tissues of the Vendace (Coregonus albula L.) in Correlation to the Iodine Content of the Ambient Water,
W86-00679 2H

LINDQVIST, O. V.
Pollution Loadings from Finnish Inland Fish-Farms: A Case Study,
W86-00680 5B

LINKINS, A. E.
Factors Controlling Mass Loss and Nitrogen Dynamics of Plant Litter Decaying in Northern Streams,
W86-00637 2K

LOBE, D. C.
UV Inactivation of Pathogenic and Indicator Microorganisms,
W86-00774 5D

LOGAN, T. J.
Effect of Aeration, Cadmium Concentration, and Solids Content on Acid Extraction of Cadmium from a Municipal Wastewater Sludge,
W86-00846 5D

LONN, B.-E.
Sublethal Effects of Simulated Pulp Mill Effluents on the Respiration and Energy Metabolism of Rainbow Trout (Salmo gairdneri),
W86-00881 5C

LOYE-PILOT, M.-D.
Variations in the Amount of Organic Carbon (Dissolved and Particulate) in a Small Mediterranean Mountain Stream (Corsica) (Les Variations des Teneurs en Carbone Organique (Dissous et Particulaire) d'un Petit Torrent Mediterraneen Montagnard (Corse)),
W86-00918 2H

LUCOTTE, M.
Comparison of Several Methods for the Determination of Iron Hydroxides and Associated Orthophosphates in Estuarine Particulate Matter,
W86-00769 2L

LUEKING, M. A.
Changes in Soil Carbon and Nitrogen Due to Irrigation Development in Nebraska's Sandhill Soils,
W86-00703 6G

LYONS, W. B.
Trace-Metal Concentrations in Sediments from Two Closed-Basin Lakes. Antarctica,
W86-00770 2H

MA, A. N.
Thermophilic Anaerobic Contact Digestion of Palm Oil Mill Effluent,
W86-00744 5D

MACCUBBIN, A. E.
Evidence for Polynuclear Aromatic Hydrocarbons in the Diet of Bottom-Feeding Fish,
W86-00694 5B

MACGREGOR, R.
Economics of Erosion Control in a Subtropical Watershed: A Dominican Case,
W86-00894 2J

MAJUMDAR, S. K.
Bacteriological Survey of Two Acid-Stressed Lakes in the Poconos before Limestone Application,
W86-00634 5C

MAKANSI, J.
Hydro-plant Upgrades Yield Reliable, Cost-effective Kilowatts,
W86-00804 8C

MALIN, V.
General Lake Water Quality Index,
W86-00673 2H

MALISSA JR, H.
Extraction and Enrichment of Chlorinated Phenols from Surface Waters for the Determination by Capillary-GC/FTIR-Spectroscopy,
W86-00824 5A

MALLEVIALLE, J.
Potential Use of Enzymes for Removal of Aromatic Compounds from Water,
W86-00753 5F

MALLEY, D. F.
Long-Term Ecosystem Stress: The Effects of Years of Experimental Acidification on a Small Lake,
W86-00688 5C

MALLIN, M. A.
Benthos-Plankton Relationship Upstream and Downstream of a Blackwater Impoundment,
W86-00620 6G

MALONEY, S. W.
Potential Use of Enzymes for Removal of Aromatic Compounds from Water,
W86-00753 5F

MANEM, J.
Potential Use of Enzymes for Removal of Aromatic Compounds from Water,
W86-00753 5F

MANI, K.
Effect of Safe Concentrations of Some Pesticides on Ovarian Recrudescence in the Freshwater Murrel, Channa punctatus (Bl.): A Quantitative Study,
W86-00872 5C

MANSELL, R. S.
Simulated Solute Movement in Wastewater-Ponded Soil,
W86-00699 5D

Solute Discharge During Steady Water Drainage from a Sand Tank,
W86-00701 2G

MARAIS, G. V. R.
Equalization Control Strategy for Activated Sludge Process Control,
W86-00749 5D

MARFENIN, N. N.
Effect of Velocity of Water Flow on Growth of Colonial Hydroids (Hydrozoa, Thecaphora),
W86-00722 2H

MARIN, C. M.
Pollutant Runoff Models: Selection and Use in Decision Making,
W86-00780 5B

MARKLUND, S.
Influence of Particulate Organics on the Removal of Dissolved Organics in Fixed-Film Biological Reactors,
W86-00735 5D

MARTIN, J. L.
Modification of a Metal Adsorption Model to Describe the Effect of pH,
W86-00847 5B

MARTIN, M. H.
Heavy Metal in Isopods from the Supra-Littoral Zone on the Southern Shore of the Severn Estuary, UK,
W86-00865 5B

MASUDA, S.
Mathematical Model of Simultaneous Organic Oxidation, Nitrification, and Denitrification in Rotating Biological Contactors,
W86-00762 5D

MATSUO, T.
Location of Phosphorus in Activated Sludge and Function of Intracellular Polyphosphates in Biological Phosphorus Removal Process,
W86-00740 5D

MATTHEWS, P. J.
Control of Metal Application Rates from Sewage Sludge Utilization in Agriculture,
W86-00854 5G

MATTHEWS, R. A.
Replacement of Stenonema spp. by Caenis diminuta Walker as the Numerical Dominant in the Mayfly Assemblage of a Thermally-Stressed Stream,
W86-00617 5C

MATZKANIN, G. A.
Surface Soil Water Content Measurement Using Pulsed Nuclear Magnetic Resonance Techniques,
W86-00698 2G

MAYEWSKI, P. A.
Trace-Metal Concentrations in Sediments from Two Closed-Basin Lakes. Antarctica,
W86-00770 2H

MAYFIELD, G. U.
Organochlorine Residues in Animals from Three Louisiana Watersheds in 1978 and 1979,
W86-00691 5B

MCAULAY, I. R.
Radiocesium Levels in Irish Sea Fish and the Resulting Dose to the Population of the Irish Republic,
W86-00822 5B

MCGUIRE, E.
What's Going on Under Chicago,
W86-00767 8A

MCKENNA, P. J.
Simulated Solute Movement in Wastewater-Ponded Soil,
W86-00699 5D

Solute Discharge During Steady Water Drainage from a Sand Tank,
W86-00701 2G

MCKEOWN, P. E.
Additions to Ichthyofauna of the Susquehanna River with a Checklist of Fishes of the Susquehanna River Drainage below Conowingo Dam,
W86-00635 2H

MCKONE, D. W.
Evaluation by Field Experiments of the McLay Model of Stream Drift,
W86-00628 2H

MEANS, J. C.
Chemical Characterization of Estuarine Colloidal Organic Matter: Implications for Adsorptive Processes,
W86-00640 2L

MEEK, M. E.
Asbestos in Drinking Water
W86-00853 5B

MELCER, H.
Application of Predenitrification Nitrification Technology for Trace Contaminant Control,
W86-00763 5D

MELILLO, J. M.
Factors Controlling Mass Loss and Nitrogen Dynamics of Plant Litter Decaying in Northern Streams,
W86-00637 2K

MERANGER, J. C.
Asbestos in Drinking Water
W86-00853 5B

MERCER, M.
Developing an Effective Storm Drainage Maintenance Program,
W86-00806 4A

MERRILL, E. G.
Carbonized Coal Products as a Source of Aromatic Hydrocarbons to Sediments from a Highly Industrialized Estuary,
W86-00896 5B

MICCOLI, J.
Separating Starvation Losses from Other Early Feeding Fry Mortality in Steelhead Trout Salmo gairdneri, Chinook Salmon Oncorhynchus tshawytscha, and Lake Trout Salvelinus namaycush,
W86-00728 5C

MIINA, T.
Natural Occurrence of Pike-Perch (Stizostedion lucioperca (L.)) and Success of Introductions in Relation to Water Quality and Lake Area in Finland,
W86-00678 2H

MIKAC, N.
Mercury Distribution in a Polluted Marine Area. Concentrations of Methyl Mercury in Sediments and Some Marine Organisms,
W86-00707 5A

MIKUTEL, D. F.
Use of Seepage Meters to Estimate Groundwater Nutrient Loading to Lakes,
W86-00788 7B

MILAZZO, D. P.
Acute and Chronic Toxicity of Technical Picloram (4-amino-3,5,6-trichloropicolinic acid) to Daphnia magna Straus,
W86-00731 5C

MILES, P. D.
Protecting Water Quality in the Midwest: Impact on Timber Harvesting Costs,
W86-00720 5D

MILLER, E. R.
Using Simulation to Assess the Impacts of Conservation Tillage on Movement of Sediment and Phosphorus into Lake Erie,
W86-00650 4D

MILLER, J. J.
Effect of Groundwater on Soil Formation in a Morainal Landscape in Saskatchewan,
W86-00670 2F

MILLER, J. M.
Analysis of Precipitation Chemistry Data from Alaska,
W86-00659 2K

MILLET, X.
Patterns of Macroinvertebrate Distribution in the Llobregat River Basin (NE Spain),
W86-00917 2H

MILLS, K. H.
Long-Term Ecosystem Stress: The Effects of Years of Experimental Acidification on a Small Lake,
W86-00688 5C

MINO, T.
Location of Phosphorus in Activated Sludge and Function of Intracellular Polyphosphates in Biological Phosphorus Removal Process,
W86-00740 5D

MIYAJI, Y.
Role of an Anaerobic Stage on Biological Phosphorus Removal,
W86-00738 5D

MONARCA, S.
Mutagenicity Assessment of Different Drinking Water Supplies before and after Treatments,
W86-00690 5A

MONKE, E. J.
Using Simulation to Assess the Impacts of Conservation Tillage on Movement of Sediment and Phosphorus into Lake Erie,
W86-00650 4D

MORTON, C. M.
Removing VOC from Groundwater; Pilot, Scale-up, and Operating Experience,
W86-00816 5F

MOSS, E. G.
Bulk Supply Scheme of the Mid Southern and North Surrey Water Companies,
W86-00835 3B

MOSS, S. J.
Heavy Metal in Isopods from the Supra-Littoral Zone on the Southern Shore of the Severn Estuary, UK,
W86-00865 5B

MROWCA, A.
Bacteriological Survey of Two Acid-Stressed Lakes in the Poconos before Limestone Application,
W86-00634 5C

MULHOLLAND, P. J.
Phosphorus Spiralling in a Woodland Stream: Seasonal Variations,
W86-00830 2H

MURTHY, R. C.
Effects of Some Divalent Metals on Cardiac and Branchial Ca2+-ATPase in Freshwater Fish Saccobranchus fossilis,
W86-00880 5C

MURTI, R.
In Vitro Effect of Mercuric Chloride on Acid and Alkaline Phosphatase Activity of a Freshwater Prawn,
W86-00625 5C

MUSCH, A.
Joint Toxicity of Mixtures of Groups of Organic Aquatic Pollutants to the Guppy (Poecilia reticulata),
W86-00876 5C

NAIMAN, R. J.
Factors Controlling Mass Loss and Nitrogen Dynamics of Plant Litter Decaying in Northern Streams,
W86-00637 2K

NAKAYAMA, M.
Separation and Determination of Selenium(IV) in Environmental Water Samples by an Anion-Exchange Resin Modified with Bismuthiol-II and Diaminonaphthalene Fluorophotometry,
W86-00825 5A

NAQVI, S. M.
Percent Mortalities and LC50 Values for Selected Microcrustaceans Exposed to Treflan, Cutrine-plus, and MSMA Herbicides,
W86-00732 5C

NEILSON, A. H.
Short-Term Test for Predicting the Potential of Xenobiotics to Impair Reproductive Success in Fish,
W86-00874 5A

NEUMANN-MAHLKAU, P.
Mobility of Zinc, Cadmium, Copper, Lead, Iron and Arsenic in Ground Water as a Function of Redox Potential and pH,
W86-00706 5B

NEWBOLD, J. D.
Phosphorus Spiralling in a Woodland Stream: Seasonal Variations,
W86-00830 2H

NEWSOM, J. D.
Organochlorine Residues in Animals from Three Louisiana Watersheds in 1978 and 1979,
W86-00691 5B

NICHOLS, A. B.
Survey Ties Needs to Water Quality,
W86-00838 5D

NICOLAS, M. E.
Effect of Drought on Metabolism and Partitioning of Carbon in Two Wheat Varieties Differing in Drought-Tolerance,
W86-00907 2I

Effects of Drought on Partitioning of Nitrogen in Two Wheat Varieties Differing in Drought-Tolerance,
W86-00908 2I

NIELSON, P. H.
Oxidation of Sulfide and Thiosulfate and Storage of Sulfur Granules in Thiothrix from Activated Sludge,
W86-00745 5D

NIEMI, M.
Potentially Toxic Blue-Green Algae (Cyanobacteria) in Finnish Natural Waters,
W86-00674 5B

NIEUWSTAD, T. J.
Modeling, Optimization and Design of Fluidized Beds for Biological Denitrification,
W86-00761 5D

NIKINMAA, M.
Sublethal Effects of Simulated Pulp Mill Effluents on the Respiration and Energy Metabolism of Rainbow Trout (Salmo gairdneri),
W86-00881 5C

NISHIDOME, K.
Mathematical Model of Simultaneous Organic Oxidation, Nitrification, and Denitrification in Rotating Biological Contactors,
W86-00762 5D

NOMANI, A. A.
Distribution of Heavy Metals in Water and Sediments of Selected Sites of Yamuna River (India); Environmental Monitoring of the Yamuna River - Part I,
W86-00685 5B

NONIDEZ, W. K.
Microarray Electrochemical Flow Detectors at High Applied Potentials and Liquid Chromatography with Electrochemical Detection of Carbamate Pesticides in River Water,
W86-00820 7B

NOVOTNY, J. F.
Invertebrate Colonization Rates in the Tailwater of a Kentucky Flood-Control Reservoir,
W86-00618 6G

NUTT, S. G.
Application of Predenitrification Nitrification Technology for Trace Contaminant Control,
W86-00763 5D

NWALA, G. N.
Binding of Cadmium, Copper, and Lead Ions by Modified Cellulosic Materials,
W86-00692 5D

OCHSENBEIN, U.
Mathematical Model for Analysis of Sediment Core Data: Implications for Enrichment Factor Calculations and Trace-Metal Transport Mechanisms,
W86-00772 5B

ODUM, W. E.
Dual-Gradient Concept of Detritus Transport and Processing in Estuaries,
W86-00641 2L

OGBEIFUN, D. E.
Binding of Cadmium, Copper, and Lead Ions by Modified Cellulosic Materials,
W86-00692 5D

OIKARI, A.
Sublethal Effects of Simulated Pulp Mill Effluents on the Respiration and Energy Metabolism of Rainbow Trout (Salmo gairdneri),
W86-00881 5C

OKIEIMEN, F. E.
Binding of Cadmium, Copper, and Lead Ions by Modified Cellulosic Materials,
W86-00692 5D

OLLIS, D. F.
Contaminant Degradation in Water,
W86-00660 5F

OMKAR,
Dichlorvos Intoxication in a Freshwater Prawn, Macrobrachium lamarrei (H. Milne Edwards),
W86-00882 5C

In Vitro Effect of Mercuric Chloride on Acid and Alkaline Phosphatase Activity of a Freshwater Prawn,
W86-00625 5C

ORIVE, E.
Chemical-Physical Changes Associated With Environmental Gradients in the Oka River Basin,
W86-00916 2H

OSE, Y.
Testing for the Toxicity of Chemicals with Tetrahymena pyriformis,
W86-00711 5A

OSHIMA, Y.
Effects of Treated Sewage Effluent and Bay-Bottom Mud on Growth of Marine Phytoplankton,
W86-00616 5C

OSSOFF, S. F.
UV Inactivation of Pathogenic and Indicator Microorganisms,
W86-00774 5D

OSTERKAMP, W. R.
Bottomland Vegetation Distribution Along Passage Creek, Virginia, In Relation to Fluvial Landforms,
W86-00826 2H

OTSUKI, A.
Occurrence of Chlorinated Polynuclear Aromatic Hydrocarbons in Tap Water,
W86-00895 5B

OU, T.-Y.
Microarray Electrochemical Flow Detectors at High Applied Potentials and Liquid Chromatography with Electrochemical Detection of Carbamate Pesticides in River Water,
W86-00820 7B

PACK, M. K.
Estimating Regional Snow Water Equivalent with a Simple Simulation Model,
W86-00789 2C

PACKHAM, P. O.
Bulk Supply Scheme of the Mid Southern and North Surrey Water Companies,
W86-00835 3B

PAERL, H. W.
Alteration of Microbial Metabolic Activities in Association with Detritus,
W86-00639 2K

PAETZOLD, R. F.
Surface Soil Water Content Measurement Using Pulsed Nuclear Magnetic Resonance Techniques,
W86-00698 2G

PARJALA, E.
Pollution Loadings from Finnish Inland Fish-Farms: A Case Study,
W86-00680 5B

PASQUINI, R.
Mutagenicity Assessment of Different Drinking Water Supplies before and after Treatments,
W86-00690 5A

PASSINO, R.
Single Sludge Anoxic-Aerobic Systems for Biological Treatment of Coke Plant Wastewaters,
W86-00765 5D

PATEL, G. N.
Distribution Pattern of Denitrifying Bacteria in Fish Ponds of Differing Farming Managements,
W86-00622 2H

PATRICK, W. H.
Nitrogen Transformations and Loss in Flooded Soils and Sediments,
W86-00849 2K

PATRICK, W. H. JR.
Nutrient Fluxes in Eutrophic Coastal Louisiana Freshwater Lake,
W86-00724 2H

PAYMENT, P.
Elimination of Viruses and Indicator Bacteria at Each Step of Treatment During Preparation of Drinking Water at Seven Water Treatment Plants,
W86-00775 5F

PEARCE, F.
Flotation that Might Sink,
W86-00831 6E

PEARSON, H. W.
Copper Toxicity to Cyanobacteria and its Dependence on Extracellular Ligand Concentration and Degradation,
W86-00910 5B

PECEVICH, P.
Ion Chromatograph Provides Rapid Analysis of Air and Water,
W86-00768 5A

PENNANEN, V.
Statistical Model for Conversion of Absorbance Measurements with Significant Iron Interference into Organic Carbon in a Polyhumic Lake,
W86-00676 5A

PERRY, J. A.
Environmental Audit. II. Application to Stream Network Design,
W86-00723 7A

PERSAUD, N.
Monte-Carlo Simulation of Noninteracting Solute Transport in a Spatially Heterogeneous Soil,
W86-00702 2G

PERSSON, P.-E.
Potentially Toxic Blue-Green Algae (Cyanobacteria) in Finnish Natural Waters,
W86-00674 5B

PERTSOV, N. A.
Growth in Biomass of Balanus balanoides Young at Various Current Velocities,
W86-00721 2H

PHIPPS, G. L.
Method for Aquatic Multiple Species Toxicant Testing: Acute Toxicity of 10 Chemicals to 5 Vertebrates and 2 Invertebrates,
W86-00654 5A

PICER, M.
Mercury Distribution in a Polluted Marine Area. Concentrations of Methyl Mercury in Sediments and Some Marine Organisms,
W86-00707 5A

PICKERING, W. F.
Sorption of Mercury(II) by Humic Acids,
W86-00866 5B

PILKINGTON, N. H.
Occurrence of Chlorinated Polynuclear Aromatic Hydrocarbons in Tap Water,
W86-00895 5B

PIRT, J.
Application of Simple Moisture Accounting Models to Ungauged Catchments,
W86-00836 2E

PLAIA, G. R.
Responses of Macrobenthos Colonizing Estuarine Sediments Contaminated with Drilling Mud Containing Diesel Oil,
W86-00730 5C

PLANTE, R.
Elimination of Viruses and Indicator Bacteria at Each Step of Treatment During Preparation of Drinking Water at Seven Water Treatment Plants,
W86-00775 5F

PLOTNIKOVA, N. A.
Growth in Biomass of Balanus balanoides Young at Various Current Velocities,
W86-00721 2H

POFF, N. L.
Replacement of Stenonema spp. by Caenis diminuta Walker as the Numerical Dominant in the Mayfly Assemblage of a Thermally-Stressed Stream,
W86-00617 5C

POOLE, S.
Destroying Pyrogens in Water,
W86-00870 5F

POST, S.
Metabolism of Aldrin by the Freshwater Planarian Phagocata gracilis,
W86-00693 5C

POTT, D. B.
Influence of pH on the Binding Capacity and Conditional Stability Constants of Aluminum and Naturally-Occurring Organic Matter,
W86-00773 2K

PRASADA RAO, K. S.
Methyl Parathion (O-O-Dimethyl O-4-Nitrophenyl Thiophosphate) Effects on Whole-Body and Tissue Respiration in the Teleost, Tilapia mossambica (Peters),
W86-00878 5C

PRAT, N.
Patterns of Macroinvertebrate Distribution in the Llobregat River Basin (NE Spain),
W86-00917 2H

PREPAS, E. E.
Comparison of the Phosphorus-Chlorophyll Relationships in Mixed and Stratified Lakes,
W86-00614 2H

PROWSE, C. W.
Field-Use of Dissolved Oxygen Electrodes,
W86-00837 5A

PUIG, M. A.
Patterns of Macroinvertebrate Distribution in the Llobregat River Basin (NE Spain),
W86-00917 2H

PYPER, J. W.
Determination of Moisture in Solids,
W86-00644 2G

RALL, G.
Bacteriological Survey of Two Acid-Stressed Lakes in the Poconos before Limestone Application,
W86-00634 5C

RAMADORI, R.
Single Sludge Anoxic-Aerobic Systems for Biological Treatment of Coke Plant Wastewaters,
W86-00765 5D

RAMAN, R. K.
In-Lake Water Quality Management Plan for a Recreational Lake in Central Illinois,
W86-00794 5G

RAMANA RAO, K. V.
Methyl Parathion (O-O-Dimethyl O-4-Nitrophenyl Thiophosphate) Effects on Whole-Body and Tissue Respiration in the Teleost, Tilapia mossambica (Peters),
W86-00878 5C

RASK, M.
Relations Between Phytoplankton and Environmental Factors in a Small, Spring-Meromictic Lake in Southern Finland,
W86-00672 2H

RECKHOW, K. H.
Pollutant Runoff Models: Selection and Use in Decision Making,
W86-00780 5B

REDDY, K. R.
Nitrogen Transformations and Loss in Flooded Soils and Sediments,
W86-00849 2K

REDPATH, K. J.
Growth Inhibition and Recovery in Mussels (Mytilus edulis) Exposed to Low Copper Concentrations,
W86-00668 5C

REGO, J. V.
Rate of Bacterial Mortality in Aquatic Environments,
W86-00777 2A

REID, J. R. JR.
Bank-Erosion Processes in a Cool-Temperate Environment, Orwell Lake, Minnesota,
W86-00898 2J

REIF, C. B.
Biolimnology of Harveys Lake,
W86-00633 2H

REIJNDERS, H. F. R.
Effects of Storage on the Composition of Main Components in Rainwater Samples,
W86-00717 2K

REKUNEN, S.
Anaerobic Wastewater Treatment System Operates at Very Low Cost,
W86-00893 5D

RICHARDS, R. P.
Utility Battles Iron and Manganese,
W86-00807 5F

RIDDER, T. B.
Effects of Storage on the Composition of Main Components in Rainwater Samples,
W86-00717 2K

RILEY, E. T.
Comparison of the Phosphorus-Chlorophyll Relationships in Mixed and Stratified Lakes,
W86-00614 2H

RITTMANN, B. E.
Effect of Load Fluctuations on the Effluent Concentration Produced by Fixed-Film Reactors,
W86-00736 5D

RIVERA, J.
Factors Influencing the High Content of Brominated Trihalomethanes in Barcelona's Water Supply (Spain),
W86-00727 5B

ROBERTS, J.
Dissolved Oxygen Concentrations in Florida's Humic-Colored Waters and Water Quality Standard Implications,
W86-00901 5G

ROBERTS, S. W.
Seasonal and Diurnal Water Relations Adjustments in Three Evergreen Chaparral Shrubs,
W86-00827 2I

ROCHOW, T. F.
Hydrologic and Vegetational Changes Resulting from Underground Pumping at the Cypress Creek Well Field, Pasco County, Florida,
W86-00899 6G

ROMM, J.
New Rules for National Forest Water,
W86-00716 6D

ROSS, B.
Influences of Snow Cover and Soil Moisture on Monthly Air Temperature,
W86-00860 2A

SALLANTAUS, T.
Quality of Runoff Water from Finnish Fuel Peat Mining Areas,
W86-00682 5B

SANDVIK, A.
Proportional Weirs for Stormwater Pond Outlets,
W86-00887 8A

SARKARIA, G. S.
Itaipu, South America's Grande Dame,
W86-00886 8A

SARNER, E.
Influence of Particulate Organics on the Removal of Dissolved Organics in Fixed-Film Biological Reactors,
W86-00735 5D

SATO, T.
Testing for the Toxicity of Chemicals with Tetrahymena pyriformis,
W86-00711 5A

SAXENA, P. K.
Effect of Safe Concentrations of Some Pesticides on Ovarian Recrudescence in the Freshwater Murrel, Channa punctatus (Bl.): A Quantitative Study,
W86-00872 5C

SCHAEFFER, D. J.
Environmental Audit. II. Application to Stream Network Design,
W86-00723 7A

SCHEPERS, J. S.
Changes in Soil Carbon and Nitrogen Due to Irrigation Development in Nebraska's Sandhill Soils,
W86-00703 6G

SCHILLINGER, J. E.
Bacterial Adsorption and Suspended Particles in Urban Stormwater,
W86-00842 5B

SCHINDLER, D. W.
Long-Term Ecosystem Stress: The Effects of Years of Experimental Acidification on a Small Lake,
W86-00688 5C

SCHNEITER, R. W.
Carbon Adsorption Isotherm Test for Volatile Organic Chemicals in Water,
W86-00845 5A

SCHWARTZ, L. N.
Effects of Sewage on Lake Champlain Wetland,
W86-00619 5C

SEHGAL, A.
Effect of pH on Toxicity of Sodium Pentachlorophenate to Fry of Common Carp in Softwater,
W86-00626 5C

SEIP, H. M.
Model of Sulphate Concentration in a Small Stream in the Harp Lake Catchment, Ontario,
W86-00629 5B

SEIP, R.
Model of Sulphate Concentration in a Small Stream in the Harp Lake Catchment, Ontario,
W86-00629 5B

SERODES, J.-B.
Influence of Salinity on Scirpus americanus Tidal Marshes in the St. Lawrence River Estuary, Quebec,
W86-00902 2L

SERVAIS, P.
Rate of Bacterial Mortality in Aquatic Environments,
W86-00777 2A

SESSIONS, S.
Innovative Water Quality-Based Permitting: A Policy Perspective,
W86-00839 5G

SETSKO, R. I.
Dynamics of the Structure of the Ichthyocenosis of Lake Ubinskoye,
W86-00912 2H

SEYFRIED, C. F.
Mixing and Detention Time Distribution in Activated Sludge Tanks,
W86-00747 5D

SFORZOLINI, G. S.
Mutagenicity Assessment of Different Drinking Water Supplies before and after Treatments,
W86-00690 5A

SHANKLIN, J.
Effect of Flooding of Soil on Growth and Subsequent Responses of Taxodium distichum Seedlings to SO2,
W86-00861 5C

SHEARER, J. A.
Long-Term Ecosystem Stress: The Effects of Years of Experimental Acidification on a Small Lake,
W86-00688 5C

SHEER, D. P.
Time and Institutional Requirements,
W86-00796 6F

SHEFFER, M. S.
Flexible Modelling of the Activated Sludge System - Theoretical and Practical Aspects,
W86-00751 5D

SHELL, R. L.
Assessment of Water Utility Information Systems and Their Use of Computers,
W86-00795 5F

SHELTON, M. L.
Modeling Hydroclimatic Processes in Large Watersheds,
W86-00647 2A

SHIBATA, M.
Role of an Anaerobic Stage on Biological Phosphorus Removal,
W86-00738 5D

SHIRAISHI, H.
Occurrence of Chlorinated Polynuclear Aromatic Hydrocarbons in Tap Water,
W86-00895 5B

SHUKLA, G. S.
Dichlorvos Intoxication in a Freshwater Prawn, Macrobrachium lamarrei (H. Milne Edwards),
W86-00882 5C

In Vitro Effect of Mercuric Chloride on Acid and Alkaline Phosphatase Activity of a Freshwater Prawn,
W86-00625 5C

SIGMAN, J. G.
City Implements Trihalomethane Control Program,
W86-00808 5F

SILVER, S. A.
Factors Influencing Hydrocarbon Degradation in Three Freshwater Lakes,
W86-00909 5B

SIMPSON, R. J.
Effect of Drought on Metabolism and Partitioning of Carbon in Two Wheat Varieties Differing in Drought-Tolerance,
W86-00907 2I

Effects of Drought on Partitioning of Nitrogen in Two Wheat Varieties Differing in Drought-Tolerance,
W86-00908 2I

SINGH, G.
Persistence of Aldrin in Flooded Soil under the Cover of Rice,
W86-00875 5B

SINGH, S. K.
Hydrous Fe and Mn Oxides - Scavengers of Heavy Metals in the Aquatic Environment,
W86-00852 5B

SIVONEN, K.
Potentially Toxic Blue-Green Algae (Cyanobacteria) in Finnish Natural Waters,
W86-00674 5B

SJOBECK, M. L.
Fish Physiology and Metal Pollution: Results and Experiences from Laboratory and Field Studies,
W86-00873 5C

SKEA, J. C.
Separating Starvation Losses from Other Early Feeding Fry Mortality in Steelhead Trout Salmo gairdneri, Chinook Salmon Oncorhynchus tshawytscha, and Lake Trout Salvelinus namaycush,
W86-00728 5C

SLANINA, J.
Effects of Storage on the Composition of Main Components in Rainwater Samples,
W86-00717 2K

SMITH, B. B.
Biolimnology of Harveys Lake,
W86-00633 2H

SMITH, M. H.
Distribution of gamma Exposure Rates In a Reactor Effluent Stream Flood Plain System,
W86-00821 5B

SMITH, R. V.
Factors Affecting Leaching of Nutrients from an Intensively Managed Grassland in County Antrim, Northern Ireland,
W86-00903 5B

SMITS, P.
Steady State Measurement of Oxygenation Capacity,
W86-00756 5D

SOMASHEKAR, R. K.
Studies of Water Pollution of the River Cauvery - Physico-Chemical Characteristics,
W86-00657 5B

SORENSEN, L.
Short-Term Test for Predicting the Potential of Xenobiotics to Impair Reproductive Success in Fish,
W86-00874 5A

SOUTHGATE, D.
Economics of Erosion Control in a Subtropical Wastershed: A Dominican Case,
W86-00894 2J

SPENCE, D. H. N.
Limnology and Macrophyte Vegetation of a Deep, Clear Limestone Lake, Loch Borralie,
W86-00905 2H

SPIEGEL, S. J.
Heavy Metal Concentrations in Municipal Wastewater Treatment Plant Sludge,
W86-00726 5B

SPRY, D. J.
Effect of Sulfite Dechlorination on the Accumulation of Waterborne Lead by Rainbow Trout (Salmo gairdneri),
W86-00615 5A

ST, R. J.
Effect of Groundwater on Soil Formation in a Morainal Landscape in Saskatchewan,
W86-00670 2F

STEED, P.
Bacteriological Survey of Two Acid-Stressed Lakes in the Poconos before Limestone Application,
W86-00634 5C

STEIN, T.
A-B Process: A Novel Two Stage Wastewater Treatment System,
W86-00750 5D

STONES, T.
Anomalies Arising from Arbitrary Measures of the Strength of Sewage,
W86-00814 5D

STOW, C. A.
Nutrient Fluxes in Eutrophic Coastal Louisiana Freshwater Lake,
W86-00724 2H

STRANDEN, E.
Radiological Impact of Mining in a Th-Rich Norwegian Area,
W86-00823 5B

STRICKMAN, D.
Aquatic Bioassay of 11 Pesticides Using Larvae of the Mosquito, Wyeomyia smithii (Diptera: Culicidae),
W86-00733 5A

STRUPLER, N.
Extent of Monochloramine Interference in the DPD Colorimetric Method for Free Chlorine in Water,
W86-00833 5A

SUBRAMANIAN, V.
Chemical Composition of River Sediments from the Indian Sub-Continent,
W86-00771 2J

Hydrous Fe and Mn Oxides - Scavengers of Heavy Metals in the Aquatic Environment,
W86-00852 5B

SUMMER, F.
Byzantine Art of Water Utility Ratemaking,
W86-00868 6C

SUNDARAM, K. M. S.
Distribution and Persistence of Aminocarb in Stream Water, Sediment and Fish After Application of Three Matacil Formulations,
W86-00811 5B

SWINK, W. D.
Invertebrate Colonization Rates in the Tailwater of a Kentucky Flood-Control Reservoir,
W86-00618 6G

SYMULA, J.
Separating Starvation Losses from Other Early Feeding Fry Mortality in Steelhead Trout Salmo gairdneri, Chinook Salmon Oncorhynchus tshawytscha, and Lake Trout Salvelinus namaycush,
W86-00728 5C

SZETO, S.
Distribution and Persistence of Aminocarb in Stream Water, Sediment and Fish After Application of Three Matacil Formulations,
W86-00811 5B

SZOLGYENYI, G.
Extraction and Enrichment of Chlorinated Phenols from Surface Waters for the Determination by Capillary-GC/FTIR-Spectroscopy,
W86-00824 5A

TABAK, J.
Bacteriological Survey of Two Acid-Stressed Lakes in the Poconos before Limestone Application,
W86-00634 5C

TABATABAI, M. A.
Effect of Acid Rain on Soils,
W86-00858 5C

TAGATZ, M. E.
Responses of Macrobenthos Colonizing Estuarine Sediments Contaminated with Drilling Mud Containing Diesel Oil,
W86-00730 5C

TALBOT, R. W.
Acidification of Southern Appalachian Lakes,
W86-00663 5B

TAMMINEN, A.
Pollution Loadings from Finnish Inland Fish-Farms: A Case Study,
W86-00680 5B

TANAKA, D. L.
Chemical and Stubble-Mulch Fallow Influences on Seasonal Soil Water Contents,
W86-00704 3F

TANAKA, H.
Separation and Determination of Selenium(IV) in Environmental Water Samples by an Anion-Exchange Resin Modified with Bismuthiol-II and Diaminonaphthalene Fluorophotometry,
W86-00825 5A

TANAKA, M.
Studies on the Sequence of 2,6-Diisopropylnaphthalene Metabolite Formation Using Carp Hepatocyte,
W86-00879 5C

TANDOI, V.
Single Sludge Anoxic-Aerobic Systems for Biological Treatment of Coke Plant Wastewaters,
W86-00765 5D

TARE, V.
New Conceptual Formulation for Predicting Filter Performance,
W86-00661 5D

TARNHOLM, A.
Short-Term Test for Predicting the Potential of Xenobiotics to Impair Reproductive Success in Fish,
W86-00874 5A

TAYLOR, F. M.
Destroying Pyrogens in Water,
W86-00870 5F

TEMPORAL, J.
Large-Diameter Flexible Steel Pipes for the Transfer Works of the Kielder Water Scheme,
W86-00832 8G

TEN BRUMMELER, E.
Methanogenesis in an Upflow Anaerobic Sludge Blanket Reactor at pH 6 on an Acetate-Propionate Mixture,
W86-00776 5D

TERASHIMA, Y.
Kinetic Analysis of BOD and Nitrogen Removal in an Oxidation Ditch,
W86-00755 5D

TERESHCHENKO, L. I.
Dynamics of the Structure of the Ichthyocenosis of Lake Ubinskoye,
W86-00912 2H

TERMAATH, S. G.
Packed Tower Aeration Strips Trichloroethylene from Groundwater,
W86-00817 5F

TESSIER, A.
Zinc Deposition in Acid Lakes: The Role of Diffusion,
W86-00689 5B

THANABALASINGAM, P.
Sorption of Mercury(II) by Humic Acids,
W86-00866 5B

THIELMANN, J.
Alluvial Fans: Novel Flood Challenge,
W86-00885 2E

THOMAS, D. M.
Removal of Arsenic from Geothermal Fluids by Adsorptive Bubble Flotation with Colloidal Ferric Hydroxide,
W86-00662 5D

TOFT, P.
Asbestos in Drinking Water
W86-00853 5B

TOWNS, A.
Distribution of gamma Exposure Rates In a Reactor Effluent Stream Flood Plain System,
W86-00821 5B

TRISKO, E. M.
Alternative Approaches to Acid Rain Control,
W86-00867 6E

TRUDEL, M.
Elimination of Viruses and Indicator Bacteria at Each Step of Treatment During Preparation of Drinking Water at Seven Water Treatment Plants,
W86-00775 5F

TRUHAUT, R.
Example of Interaction Between Environmental Pollutants: Modification of Thiram Toxicity to Freshwater Organisms by Nitrites or Nitrates in Relation to Nitrosamine Synthesis,
W86-00877 5C

TRZECIAK, L.
Evidence for Polynuclear Aromatic Hydrocarbons in the Diet of Bottom-Feeding Fish,
W86-00694 5B

TSAI, E. C.
Statistical Determination of the Optimal Sample Size of Secondary Effluent BOD5 and SS,
W86-00683 5A

TSUMURA, K.
Flexible Modelling of the Activated Sludge System - Theoretical and Practical Aspects,
W86-00751 5D

TSYGANKOVA, L. P.
Growth in Biomass of Balanus balanoides Young at Various Current Velocities,
W86-00721 2H

TULLIS, R. E.
Quantitative Structure-Toxicity Relationships with Osmotically Stressed Artemia salina Nauplii,
W86-00864 5C

VACHON, D. T.
Removal of Iron Cyanide from Gold Mill Effluents by Ion Exchange,
W86-00757 5D

VAN DEN BERG, L.
Performance of an Upflow Anaerobic Reactor Combining a Sludge Blanket and a Filter Treating Sugar Waste,
W86-00889 5D

VAN DIJK, J. C.
Phosphate Removal by Crystallization in a Fluidized Bed,
W86-00742 5D

VAN GRIEKEN, R.
Chemical Composition of River Sediments from the Indian Sub-Continent,
W86-00771 2J

VAN 'T DACK, L.
Chemical Composition of River Sediments from the Indian Sub-Continent,
W86-00771 2J

VARIS, O.
Water Quality Model for Lake Kuortaneenjarvi, a Polyhumic Finnish Lake,
W86-00677 2H

VASCONCELOS, G. J.
Microbiological Quality of Recreational Waters in the Pacific Northwest,
W86-00840 5B

VASSEUR, P.
Example of Interaction Between Environmental Pollutants: Modification of Thiram Toxicity to Freshwater Organisms by Nitrites or Nitrates in Relation to Nitrosamine Synthesis,
W86-00877 5C

VAUGHAN, G.
Kinetic Studies of the Microbiological Conversion of Sulphate to Hydrogen Sulphide and Their Relevance to Sulphide Generation Within Sewers,
W86-00746 5D

VEBER, K.
Toxicity and Accumulation of Copper and Cadmium in the Alga Scenedesmus obliquus LH,
W86-00697 5C

VELOZ, A.
Economics of Erosion Control in a Subtropical Watershed: A Dominican Case,
W86-00894 2J

VENKATARAMANI, E. S.
Biological Treatment of Landfill Leachates,
W86-00856 5D

VENKOBACHAR, C.
New Conceptual Formulation for Predicting Filter Performance,
W86-00661 5D

VENTURA, F.
Factors Influencing the High Content of Brominated Trihalomethanes in Barcelona's Water Supply (Spain),
W86-00727 5B

VERSPRILLE, A. I.
A-B Process: A Novel Two Stage Wastewater Treatment System,
W86-00750 5D

VERTA, M.
Mercury Cycle in Lakes; Some New Hypotheses,
W86-00681 5B

VICTOR, R.
Macrobenthic Invertebrates of a Perturbed Stream in Southern Nigeria,
W86-00652 5C

VIESSMAN, W. JR.
Addressing Social and Environmental Issues in Water Resources Planning and Management,
W86-00793 6A

VIGON, B. W.
Status of Nonpoint Source Pollution: Its Nature, Extent and Control,
W86-00779 5B

VIKTOR, T.
Short-Term Test for Predicting the Potential of Xenobiotics to Impair Reproductive Success in Fish,
W86-00874 5A

VILENKIN, B. Y.
Growth in Biomass of Balanus balanoides Young at Various Current Velocities,
W86-00721 2H

VIRARAGHAVAN, T.
Activated Biofilter Process for Wastewater Treatment,
W86-00871 5D

WADE, T. L.
Carbonized Coal Products as a Source of Aromatic Hydrocarbons to Sediments from a Highly Industrialized Estuary,
W86-00896 5B

WAGENER, S. M.
Gold-Mining Effects on Heavy Metals in Streams, Circle Quadrangle, Alaska,
W86-00786 5C

WALKER, R. O. JR.
Barrier to Upgrading Funding,
W86-00797 6C

WALSH, J. E.
Influences of Snow Cover and Soil Moisture on Monthly Air Temperature,
W86-00860 2A

WALSH, S. J.
Geographic Information Systems for Natural Resource Management,
W86-00649 7C

WANTAWIN, C.
Mathematical Model of Simultaneous Organic Oxidation, Nitrification, and Denitrification in Rotating Biological Contactors,
W86-00762 5D

WARNER, F. D.
Evaluation of Temperature Effects on Trickling Filter Plant Performance,
W86-00737 5D

WASSON, G. P.
Activated Biofilter Process for Wastewater Treatment,
W86-00871 5D

WATANABE, Y.
Mathematical Model of Simultaneous Organic Oxidation, Nitrification, and Denitrification in Rotating Biological Contactors,
W86-00762 5D

WATENPAUGH, D. E.
Nitrite Exposure and Respiration Rates in Fathead Minnows,
W86-00729 5C

WATKIN, A. T.
Development of Pollutant Specific Models for Toxic Organic Compounds in the Activated Sludge Process,
W86-00754 5D

WAYLEN, P. R.
Stochastic Flood Analysis in a Region of Mixed Generating Processes,
W86-00646 2E

WEBER, W. J. JR.
Lumped-Parameter Modeling of Multicomponent Adsorption in the Treatment of Coal-Conversion Wastewater by GAC,
W86-00815 5D

WEBSTER, J. R.
Phosphorus Spiralling in a Woodland Stream: Seasonal Variations,
W86-00830 2H

WEINBERGER, P.
Sorptive Capacity of an Aquatic Macrophyte for the Pesticide Aminocarb,
W86-00812 5A

WELLS, M. R.
Metabolism of Aldrin by the Freshwater Planarian Phagocata gracilis,
W86-00693 5C

WETZEL, R. G.
Accumulation of Sediment Organic Matter in a Hardwater Lake with Reference to Lake Ontogeny,
W86-00643 2J

WHARFE, J. R.
Environmental Impact of Paper Mill Waste Discharges to the Swale,
W86-00863 5C

WHITE, R. J.
PCBs in Striped Bass Collected from the Hudson River, New York, During Fall, 1981,
W86-00695 5C

WHITEN, K. K.
Microarray Electrochemical Flow Detectors at High Applied Potentials and Liquid Chromatography with Electrochemical Detection of Carbamate Pesticides in River Water,
W86-00820 7B

WIGLE, D. T.
Asbestos in Drinking Water
W86-00853 5B

WIJAYARATNE, R. D.
Chemical Characterization of Estuarine Colloidal Organic Matter: Implications for Adsorptive Processes,
W86-00640 2L

WILCOXON, N.
Use of a Swirl Concentrator for Combined Sewer Overflow Management,
W86-00844 5D

WILLEY, B. R.
Innovative Water Management Plan Reduces Treatment Costs,
W86-00841 5D

WILSON, S. J.
Chemical Composition of Highway Drainage Waters; I. Major Ions and Selected Trace Metals,
W86-00708 5B

Chemical Composition of Highway Drainage Waters; II. Chemical Associations of Metals in the Suspended Sediment,
W86-00709 5B

Chemical Composition of Highway Drainage Waters; III. Runoff Water Metal Speciation Characteristics,
W86-00710 5B

WINCHESTER, E. L.
Activated Biofilter Process for Wastewater Treatment,
W86-00871 5D

WINSAUER, K.
Extraction and Enrichment of Chlorinated Phenols from Surface Waters for the Determination by Capillary-GC/FTIR-Spectroscopy,
W86-00824 5A

WINTER, C. T.
Influence of Extended Anaerobic Retention Time on the Performance of Phoredox Nutrient Removal Plants,
W86-00739 5D

WONG, M. H.
Toxic Effects of Iron Ore Tailings and the Response of Watercress from Tailings at High Concentrations of Fe, Zn and Mn,
W86-00653 5C

YADAV, G. S.
Persistence of Aldrin in Flooded Soil under the Cover of Rice,
W86-00875 5B

YEOH, B. G.
Thermophilic Anaerobic Contact Digestion of Palm Oil Mill Effluent,
W86-00744 5D

YOON, T. I.
Influence of Macromixing on Organic Carbon Uptake and Solids Production by Aerobic Suspended Biomass,
W86-00748 5D

YOSHIDA, T.
Studies on the Sequence of 2,6-Diisopropylnaphthalene Metabolite Formation Using Carp Hepatocyte,
W86-00879 5C

YOSHIOKA, Y.
Testing for the Toxicity of Chemicals with Tetrahymena pyriformis,
W86-00711 5A

ZAHRADNIK, J.
Toxicity and Accumulation of Copper and Cadmium in the Alga Scenedesmus obliquus LH,
W86-00697 5C

ZEHNDER, A. J. B.
Methanogenesis in an Upflow Anaerobic Sludge Blanket Reactor at pH 6 on an Acetate-Propionate Mixture,
W86-00776 5D

ZUURVEEN, B.
A-B Process: A Novel Two Stage Wastewater Treatment System,
W86-00750 5D

ZWEIG, R. D.
Freshwater Aquaculture in China: Ecosystem Management for Survival,
W86-00664 2H

ORGANIZATIONAL INDEX

ABERDEEN UNIV. (SCOTLAND). DEPT. OF BOTANY.
Some Mire Systems in Japan,
W86-00904 2H

AGRICULTURAL RESEARCH AND EDUCATION CENTER, SANFORD, FL.
Nitrogen Transformations and Loss in Flooded Soils and Sediments,
W86-00849 2K

AGRICULTURAL RESEARCH SERVICE, BELTSVILLE, MD. HYDROLOGY LAB.
Surface Soil Water Content Measurement Using Pulsed Nuclear Magnetic Resonance Techniques,
W86-00698 2G

AGRICULTURAL RESEARCH SERVICE, SIDNEY, MT. NORTHERN PLAINS SOIL AND WATER RESEARCH CENTER.
Chemical and Stubble-Mulch Fallow Influences on Seasonal Soil Water Contents,
W86-00704 3F

AGRICULTURAL UNIV., WAGENINGEN (NETHERLANDS). DEPT. OF WATER POLLUTION CONTROL.
Methanogenesis in an Upflow Anaerobic Sludge Blanket Reactor at pH 6 on an Acetate-Propionate Mixture,
W86-00776 5D

AIR FORCE ENGINEERING AND SERVICES CENTER, TYNDALL AFB, FL.
Packed Tower Aeration Strips Trichloroethylene from Groundwater,
W86-00817 5F

AIR FORCE OCCUPATIONAL AND ENVIRONMENTAL HEALTH LAB., BROOKS AFB, TX.
Aquatic Bioassay of 11 Pesticides Using Larvae of the Mosquito, Wyeomyia smithii (Diptera: Culicidae),
W86-00733 5A

AIX-MARSEILLE-3 UNIV. (FRANCE). FACULTE DES SCIENCES ET TECHNIQUES.
Abiotic and Hydrobiologic Characteristics of the Mediterranean Running Waters (Caracteristiques Abiotiques and Hydrobiologiques des Eaux Courantes Mediterraneennes),
W86-00919 2H

AKADEMIYA NAUK SSSR, MOSCOW. INST. OF EVOLUTIONARY MORPHOLOGY AND ANIMAL ECOLOGY.
Growth in Biomass of Balanus balanoides Young at Various Current Velocities,
W86-00721 2H

ALASKA COOPERATIVE FISHERY RESEARCH UNIT, FAIRBANKS.
Gold-Mining Effects on Heavy Metals in Streams, Circle Quadrangle, Alaska,
W86-00786 5C

ALASKA UNIV., FAIRBANKS. INST. OF WATER RESOURCES.
Gold-Mining Effects on Stream Hydrology and Water Quality, Circle Quadrangle, Alaska,
W86-00785 4C

ALBERTA UNIV., EDMONTON. DEPT. OF CIVIL ENGINEERING.
Batch Anaerobic Methanogensis of Phenolic Coal Conversion Wastewater,
W86-00743 5D

Development of a New Process for Treating Uranium Mining Effluents,
W86-00759 5D

ALBERTA UNIV., EDMONTON. DEPT. OF ZOOLOGY.
Comparison of the Phosphorus-Chlorophyll Relationships in Mixed and Stratified Lakes,
W86-00614 2H

ALIGARH MUSLIM UNIV. (INDIA). ENVIRONMENTAL RESEARCH LAB.
Distribution of Heavy Metals in Water and Sediments of Selected Sites of Yamuna River (India); Environmental Monitoring of the Yamuna River - Part I,
W86-00685 5B

AMSTERDAM PUBLIC WORKS (NETHERLANDS). SEWERAGE AND DRAINAGE DEPT.
Steady State Measurement of Oxygenation Capacity,
W86-00756 5D

ANGLIAN WATER AUTHORITY, HUNTINGDON (ENGLAND). DIRECTORATE OF SCIENTIFIC SERVICES.
Control of Metal Application Rates from Sewage Sludge Utilization in Agriculture,
W86-00854 5G

ARIZONA UNIV., TUCSON. DEPT. OF SOILS, WATER AND ENGINEERING.
Length and Slope Effects on Runoff from Sodium Dispersed, Compacted Earth Microcatchments,
W86-00705 3B

BABTIE, SHAW AND MORTON, GLASGOW (SCOTLAND).
Large-Diameter Flexible Steel Pipes for the Transfer Works of the Kielder Water Scheme,
W86-00832 8G

BANGALORE UNIV. (INDIA). DEPT. OF BOTANY.
Studies of Water Pollution of the River Cauvery - Physico-Chemical Characteristics,
W86-00657 5B

BARCELONA UNIV. (SPAIN). DEPT. DE ECOLOGIA.
Patterns of Macroinvertebrate Distribution in the Llobregat River Basin (NE Spain),
W86-00917 2H

BATTELLE COLUMBUS DIV., OH.
Status of Nonpoint Source Pollution: Its Nature, Extent and Control,
W86-00779 5B

BAXTER AND WOODMAN, INC., CRYSTAL LAKE, IL.
Storm Water Runoff from Industrial Sites,
W86-00766 5B

BENIN UNIV., BENIN CITY (NIGERIA). DEPT. OF CHEMISTRY.
Binding of Cadmium, Copper, and Lead Ions by Modified Cellulosic Materials,
W86-00692 5D

BENIN UNIV., BENIN CITY (NIGERIA). DEPT. OF ZOOLOGY.
Macrobenthic Invertebrates of a Perturbed Stream in Southern Nigeria,
W86-00652 5C

BIOLOGICAL STATION, LUNZ AM SEE (AUSTRIA).
Organic Matter in Gravel Streams (Project RITRODAT-LUNZ),
W86-00913 2H

BRIGHAM YOUNG UNIV., PROVO, UT.
Factors Affecting Stream Transport of Combined Sewer Overflow Sediments,
W86-00843 5B

BRISTOL UNIV. (ENGLAND). DEPT. OF BOTANY.
Heavy Metal in Isopods from the Supra-Littoral Zone on the Southern Shore of the Severn Estuary, UK,
W86-00865 5B

BRITISH COLUMBIA UNIV., VANCOUVER. INST. OF ANIMAL RESOURCE ECOLOGY.
Evaluation by Field Experiments of the McLay Model of Stream Drift,
W86-00628 2H

BRUSSELS UNIV. (BELGIUM). LAB. D'OCEANOGRAPHIE.
Rate of Bacterial Mortality in Aquatic Environments,
W86-00777 2A

BUHRMANN-TETTERODE N.V., ROERMOND (NETHERLANDS). WASTEWATER DEPT.
Anaerobic Pretreatment Reduces Mill Costs, Improves Effluent Quality,
W86-00890 5D

BUREAU OF METEOROLOGY, MELBOURNE (AUSTRALIA).
Rain Estimation in Extratropical Cyclones Using GMS Imagery,
W86-00859 2B

C3 INTERNATIONAL, MINNEAPOLIS, MN.
Total Effluent Treatment and Rinse Water Reclamation in a Semiconductor Device Manufacturing Facility,
W86-00758 5D

CALIFORNIA STATE UNIV., HAYWARD. DEPT. OF BIOLOGICAL SCIENCES.
Quantitative Structure-Toxicity Relationships with Osmotically Stressed Artemia salina Nauplii,
W86-00864 5C

CALIFORNIA STATE UNIV., NORTHRIDGE.
Bacterial Adsorption and Suspended Particles in Urban Stormwater,
W86-00842 5B

CALIFORNIA UNIV., BERKELEY. DEPT. OF FORESTRY AND RESOURCES MANAGEMENT.
New Rules for National Forest Water,
W86-00716 6D

CALIFORNIA UNIV., BERKELEY. DEPT. OF ZOOLOGY.
Fate and Effects of Organotin Compounds,
W86-00665 5B

CALIFORNIA UNIV., DAVIS. DEPT. OF GEOGRAPHY.
Modeling Hydroclimatic Processes in Large Watersheds,
W86-00647 2A

CALIFORNIA UNIV., SANTA BARBARA. DEPT. OF GEOGRAPHY.
Historical Changes in Submerged Macrophyte Communities of Upper Chesapeake Bay,
W86-00828 2H

CANADA CENTRE FOR INLAND WATERS, BURLINGTON (ONTARIO).
Effect of Sulfite Dechlorination on the Accumulation of Waterborne Lead by Rainbow Trout (Salmo gairdneri),
W86-00615 5A

CANADIAN APPLIED TECHNOLOGY, TORONTO (ONTARIO).
Monitoring Urban Waterways to Reduce Flood Damage and Ensure Public Safety,
W86-00687 4A

CAPE MAY COUNTY (NJ) MUNICIPAL UTILITIES AUTHORITY.
Enclosed Vessel Composting Begins at Cape May County,
W86-00713 5E

CAPE TOWN UNIV. (SOUTH AFRICA). DEPT. OF CHEMICAL ENGINEERING.
Equalization Control Strategy for Activated Sludge Process Control,
W86-00749 5D

CAROLINA POWER AND LIGHT CO., NEW HILL, NC. HARRIS ENERGY AND ENVIRONMENTAL CENTER.
Benthos-Plankton Relationship Upstream and Downstream of a Blackwater Impoundment,
W86-00620 6G

CH2M HILL, INC., CORVALLIS, OR.
Removing VOC from Groundwater; Pilot, Scale-up, and Operating Experience,
W86-00816 5F

CHINESE UNIV. OF HONG KONG, SHATIN. DEPT. OF BIOLOGY.
Toxic Effects of Iron Ore Tailings and the Response of Watercress from Tailings at High Concentrations of Fe, Zn and Mn,
W86-00653 5C

CINCINNATI UNIV., OH. DEPT. OF MECHANICAL AND INDUSTRIAL ENGINEERING.
Assessment of Water Utility Information Systems and Their Use of Computers,
W86-00795 5F

CLEMSON UNIV., SC. DEPT. OF ENVIRONMENTAL SYSTEMS ENGINEERING.
Acidification of Southern Appalachian Lakes,
W86-00663 5B

CLEVELAND STATE UNIV., OH. DEPT. OF CIVIL ENGINEERING.
Effect of Temperature on Oxygen Transfer Rate in Wastewater Treatment,
W86-00658 5D

COLORADO STATE UNIV., FORT COLLINS. DEPT. OF ZOOLOGY AND ENTOMOLOGY.
Replacement of Stenonema spp. by Caenis diminuta Walker as the Numerical Dominant in the Mayfly Assemblage of a Thermally-Stressed Stream,
W86-00617 5C

CONSERVATION DE LA FAUNE, SAINT-SULPICE (SWITZERLAND).
Oligochaete Communities of the Sublittoral as Indicators of Lake Geneva Eutrophication,
W86-00624 5A

CRAWFORD, MURPHY AND TILLY, INC., SPRINGFIELD, IL.
Use of a Swirl Concentrator for Combined Sewer Overflow Management,
W86-00844 5D

CULP/WESNER/CULP, DENVER, CO.
Innovative Water Management Plan Reduces Treatment Costs,
W86-00841 5D

D.A.V. COLL., MUZAFFARNAGAR (INDIA). POLLUTION RELEVANT RESEARCH LAB.
In Vitro Effect of Mercuric Chloride on Acid and Alkaline Phosphatase Activity of a Freshwater Prawn,
W86-00625 5C

Dichlorvos Intoxication in a Freshwater Prawn, Macrobrachium lamarrei (H. Milne Edwards),
W86-00882 5C

DE LEUW, CATHER AND CO., CHICAGO, IL.
What's Going on Under Chicago,
W86-00767 8A

DELHI UNIV. (INDIA). DEPT. OF ANTHROPOLOGY.
Effect of pH on Toxicity of Sodium Pentachlorophenate to Fry of Common Carp in Softwater,
W86-00626 5C

DEPARTMENT OF AGRICULTURE FOR NORTHERN IRELAND, ANTRIM. FRESHWATER BIOLOGICAL INVESTIGATION UNIT.
Factors Affecting Leaching of Nutrients from an Intensively Managed Grassland in County Antrim, Northern Ireland,
W86-00903 5B

DEPARTMENT OF ECONOMIC DEVELOPMENT, LISBURN (NORTHERN IRELAND). WATER QUALITY BRANCH.
Removal of Phosphate at Sewage Treatment Works and Implications on Phosphate Loadings into Lough Neagh,
W86-00834 5D

DEPARTMENT OF ENERGY, MORGANTOWN, WV. MORGANTOWN ENERGY TECHNOLOGY CENTER.
Salinity Issues and Water Development in the Green River Basin, Wyoming,
W86-00783 6E

DEPARTMENT OF FISHERIES AND OCEANS, WINNIPEG (MANITOBA). FRESHWATER INST.
Long-Term Ecosystem Stress: The Effects of Years of Experimental Acidification on a Small Lake,
W86-00688 5C

DEPARTMENT OF NATIONAL HEALTH AND WELFARE, OTTAWA (ONTARIO). HEALTH PROTECTION BRANCH.
Asbestos in Drinking Water
W86-00853 5B

DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH, PALMERSTON NORTH (NEW ZEALAND). DIV. OF PLANT PHYSIOLOGY.
Solute Dispersion During Axisymmetric Three-Dimensional Unsaturated Water Flow,
W86-00700 2G

DHV CONSULTING ENGINEERS, AMERSFOORT (NETHERLANDS).
Phosphate Removal by Crystallization in a Fluidized Bed,
W86-00742 5D

DOW CHEMICAL U.S.A., MIDLAND, MI. MAMAMMALIAN AND ENVIRONMENTAL TOXICOLOGY.
Acute and Chronic Toxicity of Technical Picloram (4-amino-3,5,6-trichloropicolinic acid) to Daphnia magna Straus,
W86-00731 5C

DUKE UNIV., DURHAM, NC. SCHOOL OF FORESTRY AND ENVIRONMENTAL STUDIES.
Pollutant Runoff Models: Selection and Use in Decision Making,
W86-00780 5B

EAST BAY MUNICIPAL UTILITY DISTRICT, OAKLAND, CA.
Overcoming the Barriers,
W86-00798 6C

Hydraulic Fill Dam Made Earthquake Resistant,
W86-00888 8A

EAST STROUDSBURG UNIV., PA. DEPT. OF CHEMISTRY.
Chemical Study of the Shohola Creek Headwaters, Pike County, Pennsylvania,
W86-00636 5B

ECOLE NORMALE SUPERIEURE, PARIS (FRANCE). LAB. DE GEOLOGIE.
Variations in the Amount of Organic Carbon (Dissolved and Particulate) in a Small Mediterranean Mountain Stream (Corsica) (Les Variations des Teneurs en Carbone Organique (Dissous et Particulaire) d'un Petit Torrent Mediterraneen Montagnard (Corse)),
W86-00918 2H

ECOLE POLYTECHNIQUE FEDERALE DE LAUSANNE (SWITZERLAND). LAB. D'HYDRAULIQUE.
Modelling Vibration and Vortex Formation at Piedra del Aguila,
W86-00800 8B

EGC-SOUTHWELL, INC., ENGLEWOOD, CO.
Proportional Weirs for Stormwater Pond Outlets,
W86-00887 8A

EIDGENOESSISCHE ANSTALT FUER WASSERVERSORGUNG, ABWASSERREINIGUNG UND GEWAESSERSCHULTZ, DUEBENDORF (SWITZERLAND).
Structured Modeling of the Anaerobic Digestion of Biomass Particulates,
W86-00848 5D

ELECTRICITE DE FRANCE, CHATOU. DIRECTION DES ETUDES ET RECHERCHES.
Impact of Hydraulic Works on Water Quality, Part Two,
W86-00802 6G

ELECTRICITY COUNCIL RESEARCH CENTRE, CAPENHURST (ENGLAND).
Destroying Pyrogens in Water,
W86-00870 5F

ENTROPY LTD., LINCOLN, MA.
Seasonal Precipitation Forecasting with a 6-7 Month Lead Time in the Pacific Northwest Using an Information Theoretic Model,
W86-00778 2B

ENVIRONMENTAL PROTECTION AGENCY, EDISON, NJ. STORM AND COMBINED SEWER TECHNOLOGY BRANCH.
Urban Runoff: Pollution Sources, Control, and Treatment,
W86-00781 5G

ENVIRONMENTAL PROTECTION AGENCY, SEATTLE, WA. REGION X.
Microbiological Quality of Recreational Waters in the Pacific Northwest,
W86-00840 5B

ENVIRONMENTAL PROTECTION SERVICE, BURLINGTON (ONTARIO). WASTE WATER TECHNOLOGY CENTRE.
Removal of Iron Cyanide from Gold Mill Effluents by Ion Exchange,
W86-00757 5D

Application of Predenitrification Nitrification Technology for Trace Contaminant Control,
W86-00763 5D

ENVIRONMENTAL PROTECTION SERVICE, EDMONTON (ALBERTA).
Statistical Determination of the Optimal Sample Size of Secondary Effluent BOD5 and SS,
W86-00683 5A

ENVIRONMENTAL PROTECTION SERVICE, JERUSALEM (ISRAEL).
Flexible Modelling of the Activated Sludge System - Theoretical and Practical Aspects,
W86-00751 5D

ENVIRONMENTAL RESEARCH LAB.- DULUTH, MN.
Method for Aquatic Multiple Species Toxicant Testing: Acute Toxicity of 10 Chemicals to 5 Vertebrates and 2 Invertebrates,
W86-00654 5A

ENVIRONMENTAL RESEARCH LAB., GULF BREEZE, FL.
Responses of Macrobenthos Colonizing Estuarine Sediments Contaminated with Drilling Mud Containing Diesel Oil,
W86-00730 5C

ESMIL INTERNATIONAL B.V., AMSTERDAM (NETHERLANDS).
A-B Process: A Novel Two Stage Wastewater Treatment System,
W86-00750 5D

ESSEN UNIV. (GESAMTHOCHSCHULE) (GERMANY, F.R.). FACHBEREICH 9 - GEOLOGIE.
Mobility of Zinc, Cadmium, Copper, Lead, Iron and Arsenic in Ground Water as a Function of Redox Potential and pH,
W86-00706 5B

FINNISH GAME AND FISHERIES RESEARCH INST., HELSINKI. FISHERIES DIV.
Natural Occurrence of Pike-Perch (Stizostedion lucioperca (L.)) and Success of Introductions in Relation to Water Quality and Lake Area in Finland,
W86-00678 2H

FISH AND WILDLIFE SERVICE, BOWLING GREEN, KY. EAST CENTRAL RESERVOIR INVESTIGATIONS.
Invertebrate Colonization Rates in the Tailwater of a Kentucky Flood-Control Reservoir,
W86-00618 6G

FITCHBURG, MA.
Net Benefit Model for Recreation Planning at Drinking Water Reservoirs,
W86-00792 6G

FLORENCE UNIV. (ITALY). IST. DI GEOLOGIA E PALEONTOLOGIA.
Seismic Microactivity and Water Level Variation in Industrial Area near Florence (Italy),
W86-00632 2F

FLORIDA INST. OF TECH., MELBOURNE. DEPT. OF ENVIRONMENTAL SCIENCES AND ENGINEERING.
Use of Seepage Meters to Estimate Groundwater Nutrient Loading to Lakes,
W86-00788 7B

Dissolved Oxygen Concentrations in Florida's Humic-Colored Waters and Water Quality Standard Implications,
W86-00901 5G

FLORIDA UNIV., GAINESVILLE. CENTER FOR WETLANDS.
Effects of Sewage on Lake Champlain Wetland,
W86-00619 5C

FLORIDA UNIV., GAINESVILLE. DEPT. OF ENVIRONMENTAL ENGINEERING SCIENCES.
Addressing Social and Environmental Issues in Water Resources Planning and Management,
W86-00793 6A

FLORIDA UNIV., GAINESVILLE. DEPT. OF PLANT PATHOLOGY.
Simulated Solute Movement in Wastewater-Ponded Soil,
W86-00699 5D

Solute Discharge During Steady Water Drainage from a Sand Tank,
W86-00701 2G

FOREST PEST MANAGEMENT INST., SAULT SAINTE MARIE (ONTARIO).
Distribution and Persistence of Aminocarb in Stream Water, Sediment and Fish After Application of Three Matacil Formulations,
W86-00811 5B

FORT COLLINS, CO.
Developing an Effective Storm Drainage Maintenance Program,
W86-00806 4A

FRESHWATER BIOLOGICAL ASSOCIATION, AMBLESIDE (ENGLAND).
Mathematical Model for Analysis of Sediment Core Data: Implications for Enrichment Factor Calculations and Trace-Metal Transport Mechanisms,
W86-00772 5B

GENERAL MOTORS RESEARCH LABS., WARREN, MI. ENVIRONMENTAL SCIENCE DEPT.
Eulerian Model for Scavenging of Pollutants by Raindrops,
W86-00718 5B

Wet and Dry Deposition Monitoring in Southeastern Michigan,
W86-00719 5A

GEOLOGICAL SURVEY, RESTON, VA.
Bottomland Vegetation Distribution Along Passage Creek, Virginia, In Relation to Fluvial Landforms,
W86-00826 2H

GEORGIA UNIV., ATHENS. DEPT. OF CHEMISTRY.
Microarray Electrochemical Flow Detectors at High Applied Potentials and Liquid Chromatography with Electrochemical Detection of Carbamate Pesticides in River Water,
W86-00820 7B

GEORGIA UNIV., ATHENS. SCHOOL OF ENVIRONMENTAL DESIGN.
Watershed Planning for Acid Mine Drainage Abatement,
W86-00787 4D

GIFU COLL. OF MEDICAL TECHNOLOGY, SEKI (JAPAN). DEPT. OF HYGIENE.
Testing for the Toxicity of Chemicals with Tetrahymena pyriformis,
W86-00711 5A

HANOVER UNIV. (GERMANY, F.R.). INST. FUER SIEDLUNGSWASSERWIRTSCHAFT.
Mixing and Detention Time Distribution in Activated Sludge Tanks,
W86-00747 5D

HARYANA AGRICULTURAL UNIV., HISSAR (INDIA). DEPT. OF ENTOMOLOGY.
Persistence of Aldrin in Flooded Soil under the Cover of Rice,
W86-00875 5B

HAWAII INST. OF GEOPHYSICS, HONOLULU.
Removal of Arsenic from Geothermal Fluids by Adsorptive Bubble Flotation with Colloidal Ferric Hydroxide,
W86-00662 5D

HEALTH EFFECTS RESEARCH LAB., RESEARCH TRIANGLE PARK, NC. CRITERIA AND SPECIAL STUDIES OFFICE.
Flowing Water Resources,
W86-00791 2A

HEBREW UNIV., JERUSALEM (ISRAEL). SCHOOL OF APPLIED SCIENCE AND TECHNOLOGY.
Evaluation of Temperature Effects on Trickling Filter Plant Performance,
W86-00737 5D

HELSINKI UNIV. (FINLAND). DEPT. OF LIMNOLOGY.
Potentially Toxic Blue-Green Algae (Cyanobacteria) in Finnish Natural Waters,
W86-00674 5B

Statistical Model for Conversion of Absorbance Measurements with Significant Iron Interference into Organic Carbon in a Polyhumic Lake,
W86-00676 5A

Quality of Runoff Water from Finnish Fuel Peat Mining Areas,
W86-00682 5B

HELSINKI UNIV. (FINLAND). DEPT. OF ZOOLOGY.
Sublethal Effects of Simulated Pulp Mill Effluents on the Respiration and Energy Metabolism of Rainbow Trout (Salmo gairdneri),
W86-00881 5C

HELSINKI UNIV., LAMMI (FINLAND). LAMMI BIOLOGICAL STATION.
Relations Between Phytoplankton and Environmental Factors in a Small, Spring-Meromictic Lake in Southern Finland,
W86-00672 2H

HELSINKI UNIV. OF TECHNOLOGY, ESPOO (FINLAND). DEPT. OF CIVIL ENGINEERING.
Water Quality Model for Lake Kuortaneenjarvi, a Polyhumic Finnish Lake,
W86-00677 2H

HIBBING PUBLIC UTILITIES COMMISSION, MN.
Utility Battles Iron and Manganese,
W86-00807 5F

HIDROPROJECTO, LISBON (PORTUGAL).
State of the Art on the Dimensioning of Spillways for Dams, Appendix: Crossed Jet Spillways (Etat des connaissances sur le dimensionnement des evacuateurs de crue des barrages, Annexe: Evacuateurs a jets croises),
W86-00655 8A

ILLINOIS STATE WATER SURVEY, PEORIA. WATER QUALITY SECTION.
In-Lake Water Quality Management Plan for a Recreational Lake in Central Illinois,
W86-00794 5G

ILLINOIS UNIV. AT URBANA-CHAMPAIGN. DEPT. OF ATMOSPHERIC SCIENCES.
Influences of Snow Cover and Soil Moisture on Monthly Air Temperature,
W86-00860 2A

ILLINOIS UNIV. AT URBANA-CHAMPAIGN. DEPT. OF CIVIL ENGINEERING.
Effect of Load Fluctuations on the Effluent Concentration Produced by Fixed-Film Reactors,
W86-00736 5D

ILLINOIS UNIV. AT URBANA-CHAMPAIGN. DEPT. OF ECOLOGY, ETHOLOGY AND EVOLUTION.
Use of Watershed Characteristics to Select Control Streams for Estimating Effects of Metal Mining Wastes on Extensively Disturbed Streams,
W86-00725 5C

INDIAN INST. OF TECH., KANPUR. DEPT. OF CIVIL ENGINEERING.
New Conceptual Formulation for Predicting Filter Performance,
W86-00661 5D

INDIANA UNIV. AT BLOOMINGTON. DEPT. OF BIOLOGY.
Relationships Between Surface Sediment Diatom Assemblages and Lakewater Characteristics in Adirondack Lakes,
W86-00829 2H

INDUSTRIAL TOXICOLOGY RESEARCH CENTRE, LUCKNOW (INDIA).
Effects of Some Divalent Metals on Cardiac and Branchial Ca2+-ATPase in Freshwater Fish Saccobranchus fossilis,
W86-00880 5C

INSTITUT ARMAND-FRAPPIER, LAVAL (QUEBEC). CENTRE DE RECHERCHE EN VIROLOGIE.
Elimination of Viruses and Indicator Bacteria at Each Step of Treatment During Preparation of Drinking Water at Seven Water Treatment Plants,
W86-00775 5F

INSTITUT NATIONAL DE LA RECHERCHE SCIENTIFIQUE, SAINTE-FOY (QUEBEC).
Zinc Deposition in Acid Lakes: The Role of Diffusion,
W86-00689 5B

INSTITUT RUDJER BOSKOVIC, ZAGREB (YUGOSLAVIA). CENTER FOR MARINE RESEARCH.
Mercury Distribution in a Polluted Marine Area. Concentrations of Methyl Mercury in Sediments and Some Marine Organisms,
W86-00707 5A

INTERNATIONAL UNION FOR CONSERVATION OF NATURE AND NATURAL RESOURCES, NEW DELHI (INDIA).
Destruction of Water Resources - The Most Critical Ecological Crisis of East Asia,
W86-00666 4C

INTERSTATE COMMISSION ON THE POTOMAC RIVER BASIN, ROCKVILLE, MD.
Time and Institutional Requirements,
W86-00796 6F

IOWA STATE UNIV., AMES. DEPT. OF AGRONOMY.
Effect of Acid Rain on Soils,
W86-00858 5C

ISTITUTO DI RICERCA SULLE ACQUE, ROME (ITALY).
Single Sludge Anoxic-Aerobic Systems for Biological Treatment of Coke Plant Wastewaters,
W86-00765 5D

ITAIPU BINACIONAL, RIO DE JANEIRO (BRAZIL).
Itaipu, South America's Grande Dame,
W86-00886 8A

JAWAHARLAL NEHRU UNIV., NEW DELHI (INDIA). SCHOOL OF ENVIRONMENTAL SCIENCES.
Chemical Composition of River Sediments from the Indian Sub-Continent,
W86-00771 2J

Hydrous Fe and Mn Oxides - Scavengers of Heavy Metals in the Aquatic Environment,
W86-00852 5B

JOHANNES KEPLER UNIV., LINZ (AUSTRIA).
Extraction and Enrichment of Chlorinated Phenols from Surface Waters for the Determination by Capillary-GC/FTIR-Spectroscopy,
W86-00824 5A

JOHNS HOPKINS UNIV., BALTIMORE, MD. DEPT. OF GEOGRAPHY AND ENVIRONMENTAL ENGINEERING.
Alternative Solutions,
W86-00799 6C

JORDAN (EDWARD C.) CO., INC., PORTLAND, ME.
Ion Exchange Potentially Effective in Reducing Effluent from Bleach Plant,
W86-00892 5D

KALYANI UNIV. (INDIA). DEPT. OF ZOOLOGY.
Distribution Pattern of Denitrifying Bacteria in Fish Ponds of Differing Farming Managements,
W86-00622 2H

KOCK AND ASSOCIATES, WENATCHEE, WA.
Modeling the Cumulative Effects of Forest Practices on Downstream Aquatic Ecosystems,
W86-00651 6G

KOZPONTI CEGKORFIZIKAI INTEZET, BUDAPEST (HUNGARY).
Density of Precipitation Chemistry Networks,
W86-00684 7A

KROUGER (I.) A/S, SOEBORG (DENMARK).
Removal of Soluble Substrates in Fixed Films,
W86-00734 5D

KUOPIO UNIV. (FINLAND). DEPT. OF APPLIED ZOOLOGY.
Iodine Content of the Tissues of the Vendace (Coregonus albula L.) in Correlation to the Iodine Content of the Ambient Water,
W86-00679 2H

KUOPIO UNIV. (FINLAND). DEPT. OF OCCUPATIONAL AND INDUSTRIAL HYGIENE.
Pollution Loadings from Finnish Inland Fish-Farms: A Case Study,
W86-00680 5B

KURITA WATER INDUSTRIES LTD., YOKOHAMA (JAPAN).
Phosphorus Removal from Wastewater by the Crystallization Method,
W86-00741 5D

KURITA WATER INDUSTRIES LTD., YOKOHAMA (JAPAN). KURITA CENTAL LABS.
Role of an Anaerobic Stage on Biological Phosphorus Removal,
W86-00738 5D

KYOTO UNIV. (JAPAN). DEPT. OF SANITARY ENGINEERING.
Kinetic Analysis of BOD and Nitrogen Removal in an Oxidation Ditch,
W86-00755 5D

LABORATOIRE NATIONAL D'HYDRAULIQUE, CHATOU (FRANCE).
Security of Groundwater Catchments Near Rivers; Charts to Determine the Variation in the Replenishment Flow (Surete des captages d'eau souterraine a proximite des rivieres; Abaques pour determiner l'evolution du debit de realimentation flow),
W86-00656 2F

LAFAYETTE COLL., EASTON, PA. DEPT. OF BIOLOGY.
Bacteriological Survey of Two Acid-Stressed Lakes in the Poconos before Limestone Application,
W86-00634 5C

LANCASTER UNIV., BAILRIGG (ENGLAND). DEPT. OF ENVIRONMENTAL SCIENCES.
Chemical Composition of Highway Drainage Waters; I. Major Ions and Selected Trace Metals,
W86-00708 5B

Chemical Composition of Highway Drainage Waters; II. Chemical Associations of Metals in the Suspended Sediment,
W86-00709 5B

Chemical Composition of Highway Drainage Waters; III. Runoff Water Metal Speciation Characteristics,
W86-00710 5B

LAVAL UNIV., QUEBEC. DEPT. OF CIVIL ENGINEERING.
Influence of Salinity on Scirpus americanus Tidal Marshes in the St. Lawrence River Estuary, Quebec,
W86-00902 2L

LAWRENCE LIVERMORE NATIONAL LAB., CA.
Determination of Moisture in Solids,
W86-00644 2G

LIVERPOOL UNIV. (ENGLAND). DEPT. OF BOTANY.
Copper Toxicity to Cyanobacteria and its Dependence on Extracellular Ligand Concentration and Degradation,
W86-00910 5B

LODZ UNIV. (POLAND). INST. OF ENVIRONMENTAL BIOLOGY.
Influence of Development of the River Widawka on the Ephemeroptera Fauna (Influence des Amenagements de la Riviere Widawka sur la Faune des Ephemeropteres),
W86-00914 5C

LOUISIANA STATE UNIV., BATON ROUGE. CENTER FOR WETLAND RESOURCES.
Nutrient Fluxes in Eutrophic Coastal Louisiana Freshwater Lake,
W86-00724 2H

LOUISIANA STATE UNIV., BATON ROUGE. DEPT. OF ENTOMOLOGY.
Organochlorine Residues in Animals from Three Louisiana Watersheds in 1978 and 1979,
W86-00691 5B

LUND UNIV. (SWEDEN). DEPT. OF ENVIRONMENTAL ENGINEERING/
Influence of Particulate Organics on the Removal of Dissolved Organics in Fixed-Film Biological Reactors,
W86-00735 5D

LUND UNIV. (SWEDEN). INST. OF GENETICS.
Allium Test on River Water from Braan and Saxan Before and After Closure of a Chemical Factory,
W86-00667 5A

MARINE BIOLOGICAL LAB., WOODS HOLE, MA.
Response of a Detrital Foodweb to Eutrophication,
W86-00638 5C

MARINE BIOLOGICAL LAB., WOODS HOLE, MA. ECOSYSTEMS CENTER.
Factors Controlling Mass Loss and Nitrogen Dynamics of Plant Litter Decaying in Northern Streams,
W86-00637 2K

MARYLAND UNIV., CAMBRIDGE. HORN POINT ENVIRONMENTAL LABS.
Spatial and Temporal Coupling of Nutrient Inputs to Estuarine Primary Production: The Role of Particulate Transport and Decomposition,
W86-00642 2L

MARYLAND UNIV., SOLOMONS. CHESAPEAKE BIOLOGICAL LAB.
Chemical Characterization of Estuarine Colloidal Organic Matter: Implications for Adsorptive Processes,
W86-00640 2L

MASSACHUSETTS UNIV. AT BOSTON. ENVIRONMENTAL SCIENCE PROGRAM.
Factors Influencing Hydrocarbon Degradation in Three Freshwater Lakes,
W86-00909 5B

MCGILL UNIV., MONTREAL (QUEBEC). INST. OF OCEANOGRAPHY.
Comparison of Several Methods for the Determination of Iron Hydroxides and Associated Orthophosphates in Estuarine Particulate Matter,
W86-00769 2L

MELBOURNE UNIV., PARKVILLE (AUSTRALIA). PLANT SCIENCES SECTION.
Effect of Drought on Metabolism and Partitioning of Carbon in Two Wheat Varieties Differing in Drought-Tolerance,
W86-00907 2I

Effects of Drought on Partitioning of Nitrogen in Two Wheat Varieties Differing in Drought-Tolerance,
W86-00908 2I

METCALF AND EDDY OF NEW YORK, NY.
Trends in Drinking Water Treatment The Shape of Things to Come,
W86-00805 5F

METEOROLOGICAL RESEARCH INST., TOKYO (JAPAN).
Chemical Components in the Precipitation at Komoro and Tsukuba, Japan in 1983,
W86-00810 5B

MIAMI UNIV., OXFORD, OH. DEPT. OF ZOOLOGY.
Effects of Municipal Sludge and Fertilizer on Heavy Metal Accumulation in Earthworms,
W86-00862 5C

MICHIGAN UNIV., ANN ARBOR.
Lumped-Parameter Modeling of Multicomponent Adsorption in the Treatment of Coal-Conversion Wastewater by GAC,
W86-00815 5D

MIDDLE TENNESSEE STATE UNIV., MURFREESBORO. DEPT. OF BIOLOGY.
Metabolism of Aldrin by the Freshwater Planarian Phagocata gracilis,
W86-00693 5C

MINNESOTA UNIV., ST. PAUL. COLL. OF VETERINARY MEDICINE.
Viral Pollution of the Marine Environment,
W86-00851 5B

MINNESOTA UNIV., ST. PAUL. DEPT. OF FOREST RESOURCES.
Protecting Water Quality in the Midwest: Impact on Timber Harvesting Costs,
W86-00720 5D

Environmental Audit. II. Application to Stream Network Design,
W86-00723 7A

MIYAZAKI UNIV. (JAPAN). DEPT. OF CIVIL ENGINEERING.
Mathematical Model of Simultaneous Organic Oxidation, Nitrification, and Denitrification in Rotating Biological Contactors,
W86-00762 5D

MONASH UNIV., CLAYTON (AUSTRALIA). DEPT. OF CHEMICAL ENGINEERING.
Kinetic Studies of the Microbiological Conversion of Sulphate to Hydrogen Sulphide and Their Relevance to Sulphide Generation Within Sewers,
W86-00746 5D

MONTPELLIER-2 UNIV. (FRANCE). LAB. DE GENIE CHIMIQUE APPLIQUE AUX BIOTECHNOLOGIES.
Influence of Macromixing on Organic Carbon Uptake and Solids Production by Aerobic Suspended Biomass,
W86-00748 5D

MOSCOW STATE UNIV. (USSR).
Effect of Velocity of Water Flow on Growth of Colonial Hydroids (Hydrozoa, Thecaphora),
W86-00722 2H

MURRAY STATE UNIV., KY. DEPT. OF BIOLOGICAL SCIENCES.
Checklist of Phytoplankton (Exclusive of Diatoms) in Kentucky Reservoir,
W86-00631 2H

NAGOYA CITY ENVIRONMENTAL POLLUTION RESEARCH INST. (JAPAN).
Separation and Determination of Selenium(IV) in Environmental Water Samples by an Anion-Exchange Resin Modified with Bismuthiol-II and Diaminonaphthalene Fluorophotometry,
W86-00825 5A

NATIONAL BOARD OF WATERS, HELSINKI (FINLAND).
Automatic Water Quality Monitoring in Rivers Exposed to Injurious Activities,
W86-00671 5A

NATIONAL BOARD OF WATERS, HELSINKI (FINLAND). WATER RESEARCH INST.
General Lake Water Quality Index,
W86-00673 2H

Filling in the Gap Between Hydrology and Hydrobiology - the Viewpoint of a Hydrologist,
W86-00675 2H

Mercury Cycle in Lakes; Some New Hypotheses,
W86-00681 5B

NATIONAL INST. FOR ENVIRONMENTAL STUDIES, TSUKUBA (JAPAN). DIV. OF CHEMISTRY AND PHYSICS.
Occurrence of Chlorinated Polynuclear Aromatic Hydrocarbons in Tap Water,
W86-00895 5B

NATIONAL INST. FOR WATER RESEARCH, PRETORIA (SOUTH AFRICA).
Influence of Extended Anaerobic Retention Time on the Performance of Phoredox Nutrient Removal Plants,
W86-00739 5D

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION, ROCKVILLE, MD. AIR RESOURCES LAB.
Analysis of Precipitation Chemistry Data from Alaska,
W86-00659 2K

NATIONAL RESEARCH COUNCIL OF CANADA, OTTAWA (ONTARIO). DIV. OF BIOLOGICAL SCIENCES.
Performance of an Upflow Anaerobic Reactor Combining a Sludge Blanket and a Filter Treating Sugar Waste,
W86-00889 5D

NATIONAL SWEDISH ENVIRONMENT PROTECTION BOARD, NYKOEPING. BRACKISH WATER TOXICOLOGY LAB.
Fish Physiology and Metal Pollution: Results and Experiences from Laboratory and Field Studies,
W86-00873 5C

NATIONAL WATER WELL ASSOCIATION, WORTHINGTON, OH.
Re-Evaluating the Extent of Groundwater Contamination,
W86-00686 5G

NEBRASKA UNIV.-LINCOLN. DEPT. OF AGRONOMY.
Changes in Soil Carbon and Nitrogen Due to Irrigation Development in Nebraska's Sandhill Soils,
W86-00703 6G

NEBRASKA UNIV.-LINCOLN. DEPT. OF CIVIL ENGINEERING.
Simulation and Decisionmaking: The Platte River Basin in Nebraska,
W86-00790 6B

NEEL-SCHAFFER, INC., JACKSON, MS.
City Implements Trihalomethane Control Program,
W86-00808 5F

NEW ALCHEMY INST., EAST FALMOUTH, MA.
Freshwater Aquaculture in China: Ecosystem Management for Survival,
W86-00664 2H

NEW HAMPSHIRE UNIV., DURHAM. DEPT. OF EARTH SCIENCES.
Trace-Metal Concentrations in Sediments from Two Closed-Basin Lakes. Antarctica,
W86-00770 2H

NEW HAMPSHIRE UNIV., DURHAM. JACKSON ESTUARINE LAB.
Biological Consequences of Ice Rafting in a New England Salt Marsh Community,
W86-00627 2L

NEW YORK STATE DEPT. OF ENVIRONMENTAL CONSERVATION, ALBANY. BUREAU OF ENVIRONMENTAL PROTECTION.
Separating Starvation Losses from Other Early Feeding Fry Mortality in Steelhead Trout Salmo gairdneri, Chinook Salmon Oncorhynchus tshawytscha, and Lake Trout Salvelinus namaycush,
W86-00728 5C

NEWCASTLE UNIV. (AUSTRALIA). DEPT. OF CHEMISTRY.
Sorption of Mercury(II) by Humic Acids,
W86-00866 5B

NOLTE (GEORGE S.) AND ASSOCIATES, SACRAMENTO, CA.
Land Application Systems For Municipal Sludge,
W86-00714 5E

NORTH CAROLINA STATE UNIV. AT RALEIGH. DEPT. OF CHEMICAL ENGINEERING.
Contaminant Degradation in Water,
W86-00660 5F

NORTH CAROLINA UNIV. AT CHAPEL HILL. DEPT. OF ENVIRONMENTAL SCIENCES AND ENGINEERING.
UV Inactivation of Pathogenic and Indicator Microorganisms,
W86-00774 5D

Evaluating Pump Characteristics in Developing Countries,
W86-00884 8C

NORTH CAROLINA UNIV. AT MOREHEAD CITY. INST. OF MARINE SCIENCES.
Alteration of Microbial Metabolic Activities in Association with Detritus,
W86-00639 2K

NORTH DAKOTA UNIV., GRAND FORKS. DEPT. OF GEOLOGY.
Bank-Erosion Processes in a Cool-Temperate Environment, Orwell Lake, Minnesota,
W86-00898 2J

NORTH SURREY WATER CO., STAINES (ENGLAND).
Bulk Supply Scheme of the Mid Southern and North Surrey Water Companies,
W86-00835 3B

NORTH TEXAS STATE UNIV., DENTON. DEPT. OF BIOLOGICAL SCIENCES.
Nitrite Exposure and Respiration Rates in Fathead Minnows,
W86-00729 5C

NORTHWESTERN STATE UNIV. OF LOUISIANA, NATCHITOCHES. DEPT. OF BIOLOGICAL SCIENCES.
Distribution of Aluminum in the Tissues of Three Fish Species,
W86-00621 5C

O'BRIEN AND GERE ENGINEERS, INC., SYRACUSE, NY.
Heavy Metal Concentrations in Municipal Wastewater Treatment Plant Sludge,
W86-00726 5B

OAK RIDGE NATIONAL LAB., TN. ENVIRONMENTAL SCIENCES DIV.
Phosphorus Spiralling in a Woodland Stream: Seasonal Variations,
W86-00830 2H

ODENSE UNIV. (DENMARK). BIOLOGICAL INST.
Oxidation of Sulfide and Thiosulfate and Storage of Sulfur Granules in Thiothrix from Activated Sludge,
W86-00745 5D

OHIO STATE UNIV., COLUMBUS.
Effect of Aeration, Cadmium Concentration, and Solids Content on Acid Extraction of Cadmium from a Municipal Wastewater Sludge,
W86-00846 5D

OHIO STATE UNIV., COLUMBUS. DEPT. OF AGRICULTURAL ECONOMICS AND RURAL SOCIOLOGY.
Economics of Erosion Control in a Subtropical Watershed: A Dominican Case,
W86-00894 2J

OKLAHOMA STATE UNIV., STILLWATER. CENTER FOR APPLICATIONS OF REMOTE SENSING.
Geographic Information Systems for Natural Resource Management,
W86-00649 7C

OSLO UNIV. (NORWAY). DEPT. OF CHEMISTRY.
Model of Sulphate Concentration in a Small Stream in the Harp Lake Catchment, Ontario,
W86-00629 5B

OTTAWA UNIV. (ONTARIO). DEPT. OF BIOLOGY.
Sorptive Capacity of an Aquatic Macrophyte for the Pesticide Aminocarb,
W86-00812 5A

PACIFIC SOUTHWEST FOREST AND RANGE EXPERIMENT STATION, BERKELEY, CA.
Estimating Regional Snow Water Equivalent with a Simple Simulation Model,
W86-00789 2C

PARIS-5 UNIV. (FRANCE). LAB. D'HYDROLOGIE.
Extent of Monochloramine Interference in the DPD Colorimetric Method for Free Chlorine in Water,
W86-00833 5A

PERUGIA UNIV. (ITALY). CATTEDRA DI IGIENE.
Mutagenicity Assessment of Different Drinking Water Supplies before and after Treatments,
W86-00690 5A

POLISH ACADEMY OF SCIENCES, KRAKOW. ZAKLAD BIOLOGII WOD.
Effect of Droughts on the Invertebrate Communities of High Mountain Streams,
W86-00915 2H

PROEFSTATION VOOR AARDAPPELVERWERKING, GROINGEN
Sulfate Determination in Industrial Wastewater by Liquid Chromatography with Postcolumn Solid-Phase Reaction Detection,
W86-00819 5A

PUNJAB AGRICULTURAL UNIV., LUDHIANA (INDIA). DEPT. OF ZOOLOGY.
Effect of Safe Concentrations of Some Pesticides on Ovarian Recrudescence in the Freshwater Murrel, Channa punctatus (Bl.): A Quantitative Study,
W86-00872 5C

PURDUE UNIV., LAFAYETTE, IN.
Barrier to Upgrading Funding,
W86-00797 6C

PURDUE UNIV., LAFAYETTE, IN. DEPT. OF AGRICULTURAL ENGINEERING.
Using Simulation to Assess the Impacts of Conservation Tillage on Movement of Sediment and Phosphorus into Lake Erie,
W86-00650 4D

PURDUE UNIV., LAFAYETTE, IN. SCHOOL OF CIVIL ENGINEERING.
Elevated Nitrite Occurrence in Biological Wastewater Treatment Systems,
W86-00764 5D

QUEEN'S UNIV., KINGSTON (ONTARIO). DEPT. OF MECHANICAL ENGINEERING.
Simple Governing and Surging Simulation, Part One,
W86-00801 8B

RADIATION MANAGEMENT CORP., DRUMORE, PA. MUDDY RUN ECOLOGICAL LAB.
Additions to Ichthyofauna of the Susquehanna River with a Checklist of Fishes of the Susquehanna River Drainage below Conowingo Dam,
W86-00635 2H

REGINA UNIV. (SASKATCHEWAN). FACULTY OF ENGINEERING.
Activated Biofilter Process for Wastewater Treatment,
W86-00871 5D

RIVERSIDE COUNTY FLOOD CONTROL AND WATER CONSERVATION DISTRICT, CA.
Alluvial Fans: Novel Flood Challenge,
W86-00885 2E

ROSWELL PARK MEMORIAL INST., BUFFALO, NY. DEPT. OF EXPERIMENTAL BIOLOGY.
Evidence for Polynuclear Aromatic Hydrocarbons in the Diet of Bottom-Feeding Fish,
W86-00694 5B

ROUEN UNIV., MONT-SAINT-AIGNAN (FRANCE). LAB. DE TOXICOLOGIE.
Example of Interaction Between Environmental Pollutants: Modification of Thiram Toxicity to Freshwater Organisms by Nitrites or Nitrates in Relation to Nitrosamine Synthesis,
W86-00877 5C

ROYAL NETHERLANDS METEOROLOGICAL INST., DE BILT.
Effects of Storage on the Composition of Main Components in Rainwater Samples,
W86-00717 2K

RUBBER RESEARCH INST. OF MALAYA, KUALA LUMPUR (MALAYSIA).
Thermophilic Anaerobic Contact Digestion of Palm Oil Mill Effluent,
W86-00744 5D

RUTGERS - THE STATE UNIV., PISCATAWAY, NJ. DEPT. OF CHEMICAL AND BIOCHEMICAL ENGINEERING.
Biological Treatment of Landfill Leachates,
W86-00856 5D

SAINT ANDREWS UNIV. (SCOTLAND). DEPT. OF BOTANY.
Aquatic Angiosperm Communities from Lochs on Rhum,
W86-00906 2H

SAINT ANDREWS UNIV. (SCOTLAND). DEPT. OF PLANT BIOLOGY AND ECOLOGY.
Limnology and Macrophyte Vegetation of a Deep, Clear Limestone Lake, Loch Borralie,
W86-00905 2H

SALT LAKE CITY DEPT. OF PUBLIC UTILITIES, UT.
Water for Salt Lake City,
W86-00809 3B

SAN DIEGO STATE UNIV., CA. DEPT. OF GEOGRAPHY.
Snowmelt Energy Budgets in Southern and East-Central Wisconsin,
W86-00648 2C

SAN DIEGO STATE UNIV., CA. SYSTEMS ECOLOGY RESEARCH GROUP.
Seasonal and Diurnal Water Relations Adjustments in Three Evergreen Chaparral Shrubs,
W86-00827 2I

SASKATCHEWAN UNIV., SASKATOON. DEPT. OF GEOGRAPHY.
Stochastic Flood Analysis in a Region of Mixed Generating Processes,
W86-00646 2E

SASKATCHEWAN UNIV., SASKATOON. SASKATCHEWAN INST. OF PEDOLOGY.
Effect of Groundwater on Soil Formation in a Morainal Landscape in Saskatchewan,
W86-00670 2F

SAVANNAH RIVER ECOLOGY LAB., AIKEN, SC.
Influence of pH on the Binding Capacity and Conditional Stability Constants of Aluminum and Naturally-Occurring Organic Matter,
W86-00773 2K

Distribution of gamma Exposure Rates In a Reactor Effluent Stream Flood Plain System,
W86-00821 5B

SEVERN-TRENT WATER AUTHORITY (ENGLAND).
Application of Simple Moisture Accounting Models to Ungauged Catchments,
W86-00836 2E

SKYLONDA GROUP, INC., MENLO PARK, CA.
Innovative Water Quality-Based Permitting: A Policy Perspective,
W86-00839 5G

SOCIEDAD GENERAL DE AGUAS DE BARCELONA (SPAIN).
Factors Influencing the High Content of Brominated Trihalomethanes in Barcelona's Water Supply (Spain),
W86-00727 5B

SOUTHERN ILLINOIS UNIV. AT CARBONDALE. DEPT. OF GEOGRAPHY.
Field-Use of Dissolved Oxygen Electrodes,
W86-00837 5A

SOUTHERN UNIV., BATON ROUGE, LA. DEPT. OF BIOLOGICAL SCIENCES.
Percent Mortalities and LC50 Values for Selected Microcrustaceans Exposed to Treflan, Cutrine-plus, and MSMA Herbicides,
W86-00732 5C

SOUTHERN WATER AUTHORITY, CHATHAM (ENGLAND). KENT DIV.
Environmental Impact of Paper Mill Waste Discharges to the Swale,
W86-00863 5C

SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT, BROOKSVILLE.
Hydrologic and Vegetational Changes Resulting from Underground Pumping at the Cypress Creek Well Field, Pasco County, Florida,
W86-00899 6G

SRI VENKATESWARA UNIV., TIRUPATI (INDIA). DEPT. OF ZOOLOGY.
Methyl Parathion (O-O-Dimethyl O-4-Nitrophenyl Thiophosphate) Effects on Whole-Body and Tissue Respiration in the Teleost, Tilapia mossambica (Peters),
W86-00878 5C

STATE UNIV. OF NEW YORK AT ALBANY. DEPT. OF ATMOSPHERIC SCIENCE.
PCBs in Striped Bass Collected from the Hudson River, New York, During Fall, 1981,
W86-00695 5C

STATENS INST. FOR STRAALEHYGIENE, OSLO (NORWAY).
Radiological Impact of Mining in a Th-Rich Norwegian Area,
W86-00823 5B

SWEDISH ENVIRONMENTAL RESEARCH INST., STOCKHOLM.
Short-Term Test for Predicting the Potential of Xenobiotics to Impair Reproductive Success in Fish,
W86-00874 5A

TAMPELLA OY A.B., TAMPERE (FINLAND).
Anaerobic Wastewater Treatment System Operates at Very Low Cost,
W86-00893 5D

TECHNICAL UNIV. OF DENMARK, LYNGBY. DEPT. OF SANITARY ENGINEERING.
Biological Removal of Phosphorus From Wastewater,
W86-00857 5D

TECHNISCHE HOGESCHOOL DELFT (NETHERLANDS). LAB. OF SANITARY ENGINEERING.
Modeling, Optimization and Design of Fluidized Beds for Biological Denitrification,
W86-00761 5D

TENNESSEE VALLEY AUTHORITY, KNOXVILLE. ENVIRONMENTAL QUALITY STAFF.
Environmental and Economic Damage Caused by Sediment from Agricultural Nonpoint Sources,
W86-00784 5C

TEXAS A AND M UNIV., COLLEGE STATION.
Monte-Carlo Simulation of Noninteracting Solute Transport in a Spatially Heterogeneous Soil,
W86-00702 2G

TEXAS A AND M UNIV., COLLEGE STATION. DEPT. OF CIVIL ENGINEERING.
Modification of a Metal Adsorption Model to Describe the Effect of pH,
W86-00847 5B

TEXAS A AND M UNIV., COLLEGE STATION. DEPT. OF OCEANOGRAPHY.
Carbonized Coal Products as a Source of Aromatic Hydrocarbons to Sediments from a Highly Industrialized Estuary,
W86-00896 5B

TEXAS AGRICULTURAL EXPERIMENT STATION, COLLEGE STATION.
Sewage Effluent Pumps,
W86-00803 5D

TEXAS TECH UNIV., LUBBOCK. DEPT. OF CHEMISTRY.
Fluorimetric Determination of Trace Hydrogen Peroxide in Water with a Flow Injection System,
W86-00645 5A

TOKYO UNIV. (JAPAN). DEPT. OF URBAN AND SANITARY ENGINEERING.
Location of Phosphorus in Activated Sludge and Function of Intracellular Polyphosphates in Biological Phosphorus Removal Process,
W86-00740 5D

TOKYO UNIV. OF FISHERIES (JAPAN). DEPT. OF MARINE ENVIRONMENTAL SCIENCE AND TECHNOLOGY.
Studies on the Sequence of 2,6-Diisopropylnaphthalene Metabolite Formation Using Carp Hepatocyte,
W86-00879 5C

TOLEDO UNIV., OH. DEPT. OF CIVIL ENGINEERING.
Dynamics of Nitrification in a Biological Fluidized Bed Reactor,
W86-00760 5D

TRINITY COLL., DUBLIN (IRELAND). DEPT. OF PURE AND APPLIED PHYSICS.
Radiocesium Levels in Irish Sea Fish and the Resulting Dose to the Population of the Irish Republic,
W86-00822 5B

TRINITY COLL., DUBLIN (IRELAND). ENVIRONMENTAL SCIENCES UNIT.
Environmental Protection in the Republic of Ireland,
W86-00813 5G

TUFTS UNIV., MEDFORD, MA. DEPT. OF CIVIL ENGINEERING.
Remote Detection of Groundwater Contaminants Using Far-Ultraviolet Laser-Induced Fluorescence,
W86-00818 7B

UDAI PRATAP COLL., VARANASI (INDIA).DEPT. OF BOTANY.
Influence of Oil Refinery Effluents on the Structure of Algal Communities,
W86-00623 5C

UNIVERSITY COLL. OF NORTH WALES, MENAI BRIDGE. MARINE SCIENCE LABS.
Growth Inhibition and Recovery in Mussels (Mytilus edulis) Exposed to Low Copper Concentrations,
W86-00668 5C

UNIVERSITY OF NORTH FLORIDA, JACKSONVILLE. DEPT. OF NATURAL SCIENCES.
Seasonal Cycles of Phytoplankton Populations and Total Chlorophyll of the Lower St. Johns River Estuary, Florida,
W86-00900 2L

UNIVERSITY OF SOUTHERN MISSISSIPPI, HATTIESBURG. DEPT. OF BIOLOGICAL SCIENCES.
Accumulation of Sediment Organic Matter in a Hardwater Lake with Reference to Lake Ontogeny,
W86-00643 2J

UTRECHT RIJKSUNIVERSITEIT (NETHERLANDS). DEPT. OF VETERINARY PHARMACOLOGY, PHARMACY AND TOXICOLOGY.
Joint Toxicity of Mixtures of Groups of Organic Aquatic Pollutants to the Guppy (Poecilia reticulata),
W86-00876 5C

VANDERBILT UNIV., NASHVILLE, TN. DEPT. OF CIVIL AND ENVIRONMENTAL ENGINEERING.
Development of Pollutant Specific Models for Toxic Organic Compounds in the Activated Sludge Process,
W86-00754 5D

VIRGINIA POLYTECHNIC INST. AND STATE UNIV., BLACKSBURG. DEPT. OF AGRICULTURAL ECONOMICS.
Farmers' Attitudes Toward Nonpoint Pollution Control and Participation in Cost-Share Programs,
W86-00782 5G

VIRGINIA UNIV., CHARLOTTESVILLE. DEPT. OF ENVIRONMENTAL SCIENCES.
Dual-Gradient Concept of Detritus Transport and Processing in Estuaries,
W86-00641 2L

Effects of Cadmium and Copper on Chemotaxis of Marine and Freshwater Ciliates,
W86-00696 5C

VYSOKA SKOLA CHEMICKO-TECHNOLOGICKA, PRAGUE (CZECHOSLOVAKIA). INST. OF WATER TECHNOLOGY AND ENVIRONMENTAL PROTECTION.
Determination of Kinetic Constants of Activated Sludge Microorganisms,
W86-00752 5D

VYSOKA SKOLA ZEMEDELSKA V PRAZE, CESKE BUDEJOVICE (CZECHOSLOVAKIA). FACULTY OF AGRICULTURAL ECONOMICS AND MANAGEMENT.

Toxicity and Accumulation of Copper and Cadmium in the Alga Scenedesmus obliquus LH,
W86-00697 5C

WATER AND WASTEWATER EQUIPMENT MFRS. ASSOCIATION, WASHINGTON, DC.

Byzantine Art of Water Utility Ratemaking,
W86-00868 6C

WATERLOO UNIV. (ONTARIO). DEPT. OF BIOLOGY.

Effects of Available Dietary Carbohydrate and Water Temperature on the Chronic Toxicity of Waterborne Copper to Rainbow Trout (Salmo gairdneri),
W86-00630 5C

WESTON (ROY F.), INC., WEST CHESTER, PA.

Sludge Management: A Research Update,
W86-00715 5E

WILKES COLL., WILKES-BARRE, PA. DEPT. OF BIOLOGY.

Biolimnology of Harveys Lake,
W86-00633 2H

WISCONSIN UNIV.-MADISON. DEPT. OF FORESTRY.

Effect of Flooding of Soil on Growth and Subsequent Responses of Taxodium distichum Seedlings to SO2,
W86-00861 5C

WORLD HEALTH ORGANIZATION, GENEVA (SWITZERLAND). DIV. OF ENVIRONMENTAL HEALTH.

Drinking-water and Sanitation Projects: Criteria for Resource Allocation,
W86-00669 5F

ACCESSION NUMBER INDEX

W86-00614 2H
W86-00615 5A
W86-00616 5C
W86-00617 5C
W86-00618 6G
W86-00619 5C
W86-00620 6G
W86-00621 5C
W86-00622 2H
W86-00623 5C
W86-00624 5A
W86-00625 5C
W86-00626 5C
W86-00627 2L
W86-00628 2H
W86-00629 5B
W86-00630 5C
W86-00631 2H
W86-00632 2F
W86-00633 2H
W86-00634 5C
W86-00635 2H
W86-00636 5B
W86-00637 2K
W86-00638 5C
W86-00639 2K
W86-00640 2L
W86-00641 2L
W86-00642 2L
W86-00643 2J
W86-00644 2G
W86-00645 5A
W86-00646 2E
W86-00647 2A
W86-00648 2C
W86-00649 7C
W86-00650 4D
W86-00651 6G
W86-00652 5C
W86-00653 5C
W86-00654 5A
W86-00655 8A
W86-00656 2F
W86-00657 5B
W86-00658 5D
W86-00659 2K
W86-00660 5F
W86-00661 5D
W86-00662 5D
W86-00663 5B
W86-00664 2H
W86-00665 5B
W86-00666 4C
W86-00667 5A
W86-00668 5C
W86-00669 5F
W86-00670 2F
W86-00671 5A
W86-00672 2H
W86-00673 2H
W86-00674 5B
W86-00675 2H
W86-00676 5A
W86-00677 2H
W86-00678 2H
W86-00679 2H
W86-00680 5B
W86-00681 5B
W86-00682 5B
W86-00683 5A
W86-00684 7A
W86-00685 5B
W86-00686 5G
W86-00687 4A
W86-00688 5C
W86-00689 5B
W86-00690 5A
W86-00691 5B
W86-00692 5D
W86-00693 5C
W86-00694 5B
W86-00695 5C
W86-00696 5C
W86-00697 5C
W86-00698 2G
W86-00699 5D
W86-00700 2G
W86-00701 2G
W86-00702 2G
W86-00703 6G
W86-00704 3F
W86-00705 3B
W86-00706 5B
W86-00707 5A
W86-00708 5B
W86-00709 5B
W86-00710 5B
W86-00711 5A
W86-00712 2F
W86-00713 5E
W86-00714 5E
W86-00715 5E
W86-00716 6D
W86-00717 2K
W86-00718 5B
W86-00719 5A
W86-00720 5D
W86-00721 2H
W86-00722 2H
W86-00723 7A
W86-00724 2H
W86-00725 5C
W86-00726 5B
W86-00727 5B
W86-00728 5C
W86-00729 5C
W86-00730 5C
W86-00731 5C
W86-00732 5C
W86-00733 5A
W86-00734 5D
W86-00735 5D
W86-00736 5D
W86-00737 5D
W86-00738 5D
W86-00739 5D
W86-00740 5D
W86-00741 5D
W86-00742 5D
W86-00743 5D
W86-00744 5D
W86-00745 5D
W86-00746 5D
W86-00747 5D
W86-00748 5D
W86-00749 5D
W86-00750 5D
W86-00751 5D
W86-00752 5D
W86-00753 5F
W86-00754 5D
W86-00755 5D
W86-00756 5D
W86-00757 5D
W86-00758 5D
W86-00759 5D
W86-00760 5D
W86-00761 5D
W86-00762 5D
W86-00763 5D
W86-00764 5D
W86-00765 5D
W86-00766 5B
W86-00767 8A
W86-00768 5A
W86-00769 2L
W86-00770 2H
W86-00771 2J
W86-00772 5B
W86-00773 2K
W86-00774 5D
W86-00775 5F
W86-00776 5D
W86-00777 2A
W86-00778 2B
W86-00779 5B
W86-00780 5B
W86-00781 5G
W86-00782 5G
W86-00783 6E
W86-00784 5C
W86-00785 4C
W86-00786 5C
W86-00787 4D
W86-00788 7B
W86-00789 2C
W86-00790 6B
W86-00791 2A
W86-00792 6G
W86-00793 6A
W86-00794 5G
W86-00795 5F
W86-00796 6F
W86-00797 6C
W86-00798 6C
W86-00799 6C
W86-00800 8B
W86-00801 8B
W86-00802 6G
W86-00803 5D
W86-00804 8C
W86-00805 5F
W86-00806 4A
W86-00807 5F
W86-00808 5F
W86-00809 3B
W86-00810 5B
W86-00811 5B
W86-00812 5A
W86-00813 5G
W86-00814 5D
W86-00815 5D
W86-00816 5F
W86-00817 5F
W86-00818 7B
W86-00819 5A
W86-00820 7B
W86-00821 5B
W86-00822 5B
W86-00823 5B
W86-00824 5A
W86-00825 5A
W86-00826 2H
W86-00827 2I
W86-00828 2H
W86-00829 2H
W86-00830 2H
W86-00831 6E
W86-00832 8G
W86-00833 5A
W86-00834 5D
W86-00835 3B
W86-00836 2E
W86-00837 5A
W86-00838 5D
W86-00839 5G
W86-00840 5B
W86-00841 5D
W86-00842 5B
W86-00843 5B
W86-00844 5D
W86-00845 5A
W86-00846 5D
W86-00847 5B
W86-00848 5D
W86-00849 2K
W86-00850 2H
W86-00851 5B
W86-00852 5B
W86-00853 5B
W86-00854 5G
W86-00855 5F
W86-00856 5D
W86-00857 5D
W86-00858 5C
W86-00859 2B
W86-00860 2A
W86-00861 5C
W86-00862 5C
W86-00863 5C
W86-00864 5C
W86-00865 5B
W86-00866 5B
W86-00867 6E
W86-00868 6C
W86-00869 3F
W86-00870 5F
W86-00871 5D
W86-00872 5C
W86-00873 5C
W86-00874 5A
W86-00875 5B
W86-00876 5C
W86-00877 5C
W86-00878 5C
W86-00879 5C
W86-00880 5C
W86-00881 5C
W86-00882 5C
W86-00883 8A
W86-00884 8C
W86-00885 2E
W86-00886 8A
W86-00887 8A
W86-00888 8A
W86-00889 5D
W86-00890 5D
W86-00891 5E
W86-00892 5D
W86-00893 5D
W86-00894 2J
W86-00895 5B
W86-00896 5B
W86-00897 2F
W86-00898 2J
W86-00899 6G
W86-00900 2L
W86-00901 5G
W86-00902 2L
W86-00903 5B
W86-00904 2H
W86-00905 2H
W86-00906 2H
W86-00907 2I
W86-00908 2I
W86-00909 5B
W86-00910 5B
W86-00911 2F
W86-00912 2H
W86-00913 2H
W86-00914 5C
W86-00915 2H
W86-00916 2H
W86-00917 2H
W86-00918 2H
W86-00919 2H

* U. S. GOVERNMENT PRINTING OFFICE : 1986 491-069/20009

Subject Fields

1 NATURE OF WATER

2 WATER CYCLE

3 WATER SUPPLY AUGMENTATION AND CONSERVATION

4 WATER QUANTITY MANAGEMENT AND CONTROL

5 WATER QUALITY MANAGEMENT AND PROTECTION

6 WATER RESOURCES PLANNING

7 RESOURCES DATA

8 ENGINEERING WORKS

9 MANPOWER, GRANTS, AND FACILITIES

10 SCIENTIFIC AND TECHNICAL INFORMATION

INDEXES

SUBJECT INDEX

AUTHOR INDEX

ORGANIZATIONAL INDEX

ACCESSSION NUMBER INDEX

NORTH AMERICAN CONTINENT PRICE SCHEDULE

Customers in Canada, United States, and Mexico please use this price schedule; other addressees, write for PR-360-4.

MICROFICHE

A01	$5.95

PAPER COPY

A02 and A03	9.95
A04 and A05	11.95
A06 through A09 (inclusive)	16.95
A10 through A13 (inclusive)	22.95
A14 through A17 (inclusive)	28.95
A18 through A21 (inclusive)	34.95
A22 through A25 (inclusive)	40.95
A99	*
N01	45.00
N02	48.00

E01	$7.50
E02	10.00
E03	11.00
E04	13.50
E05	15.50
E06	18.00
E07	20.50
E08	23.00
E09	25.50
E10	28.00
E11	30.50
E12	33.00
E13	35.50
E14	38.50
E15	42.00
E16	46.00
E17	50.00
E18	54.00
E19	60.00
E20	70.00
E99	*

T01	$145.00
T02	160.00
T03	275.00
T04	370.00
T05	460.00
T06	535.00
T07	610.00
T08	685.00
T09	760.00
T10	835.00
T11	910.00
T12	985.00
T13	1,060.00
T14	1,135.00
T15	1,210.00
T16	1,285.00
T17	1,360.00
T18	1,435.00
T19	1,510.00
T99	*

*Contact NTIS for price quote.

PRICES EFFECTIVE JANUARY 1, 1986

U.S. DEPARTMENT OF COMMERCE
National Technical Information Service
5285 Port Royal Road
Springfield, VA 22161

OFFICIAL BUSINESS

Penalty for Private Use, $300

AN EQUAL OPPORTUNITY EMPLOYER

BULK RATE
POSTAGE & FEES PAID
NTIS
Permit No. G-292